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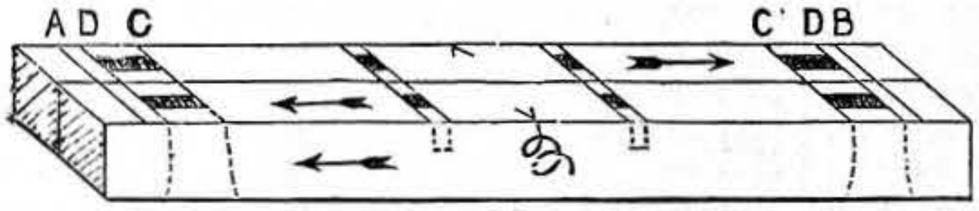
Fig. 2.—Mode of Setting out Stiles.

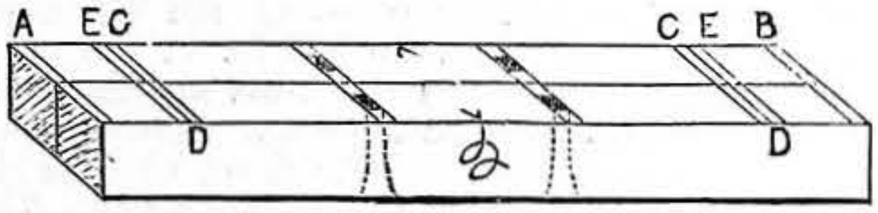

Fig. 3.—Mode of Setting out Rails.

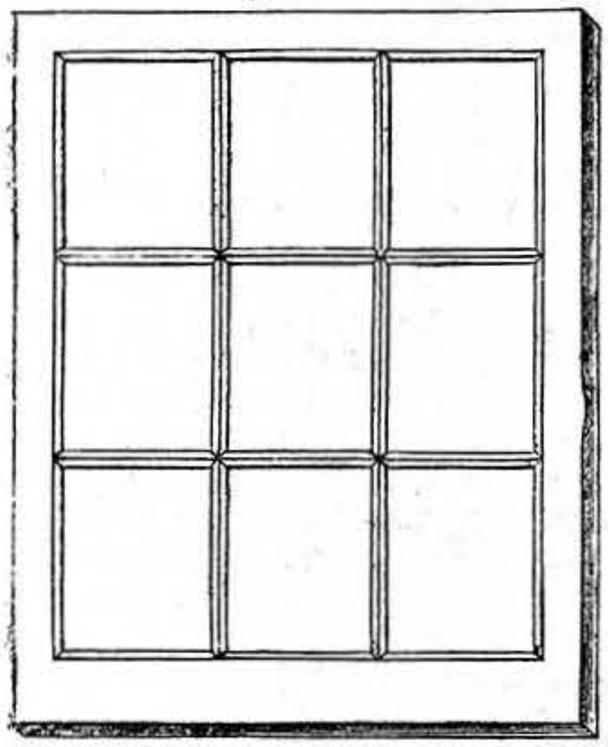

Fig. 1.—Elevation of Common Sash.

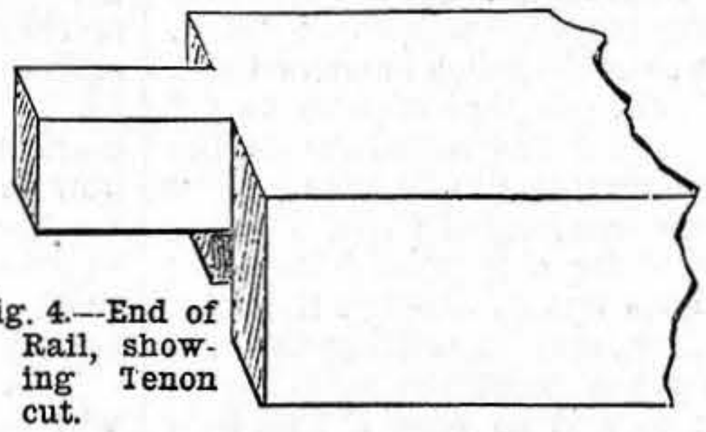

Fig. 4.—End of Rail, showing Tenon cut.

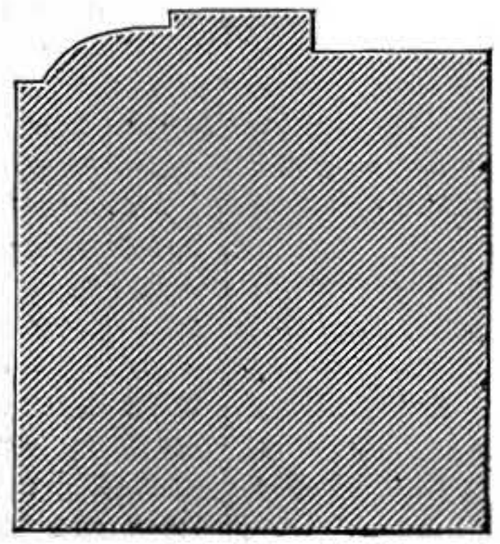

Fig. 14.—Section of Sash Framing.

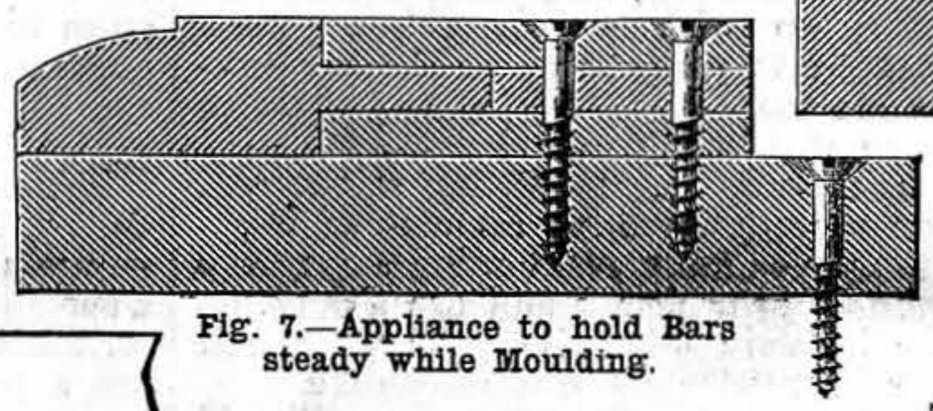

Fig. 7.—Appliance to hold Bars steady while Moulding.

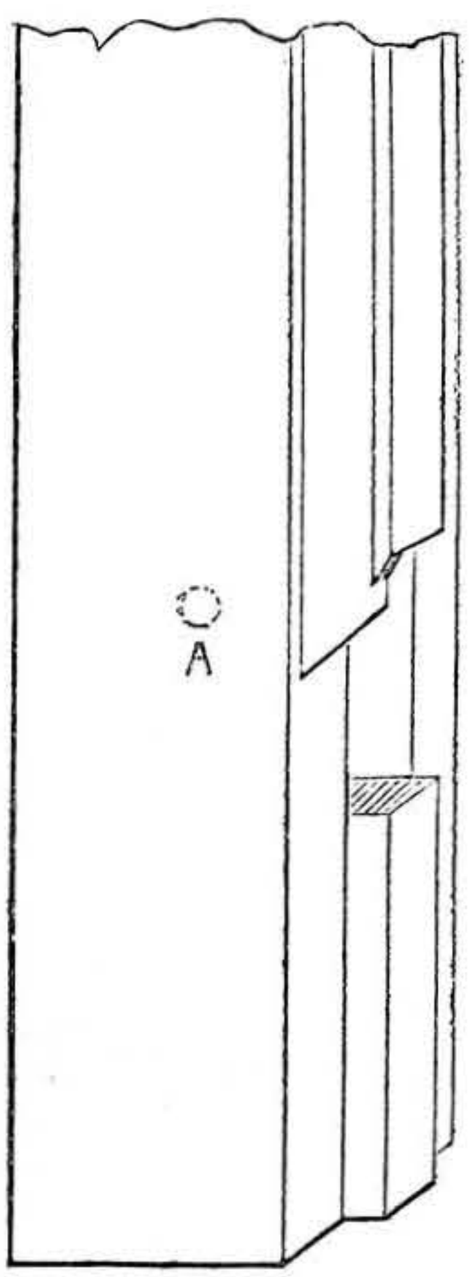

Fig. 9.—End of Stile, showing Mitre and Cutting.

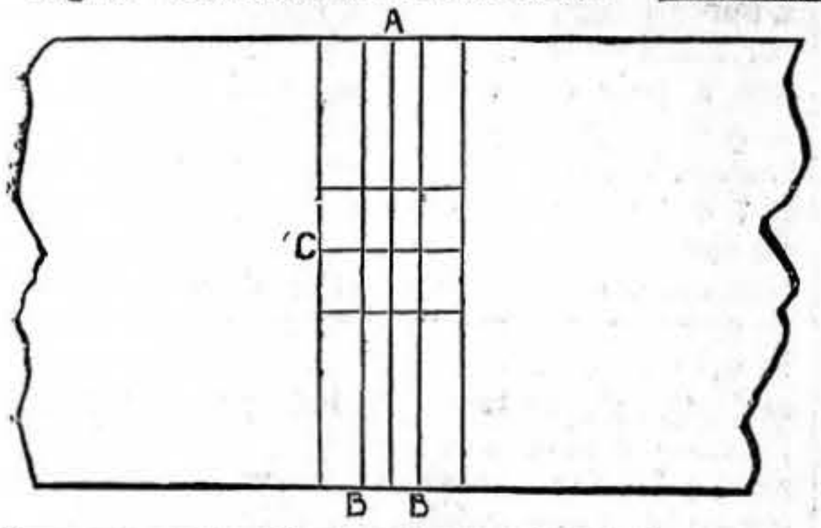

Fig. 5.—Mode of Setting out Mortises, etc., of Cross-bars.

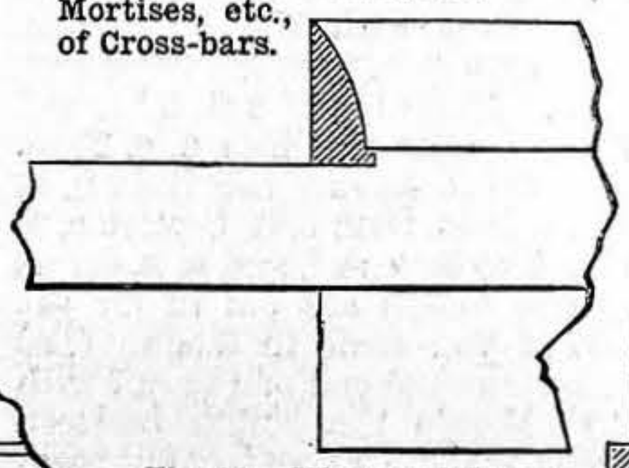

Fig. 11.—Mitre and Tenon of Bars (Ends).

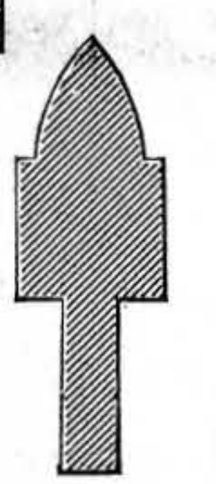

Fig. 15.—Section of Sash-bar.

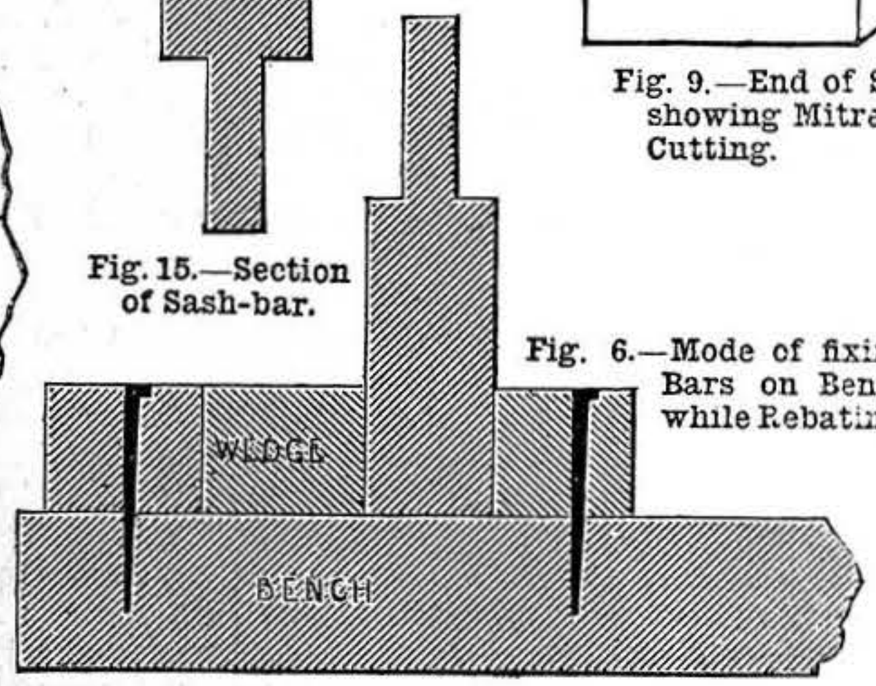

Fig. 6.—Mode of fixing Bars on Bench while Rebating.

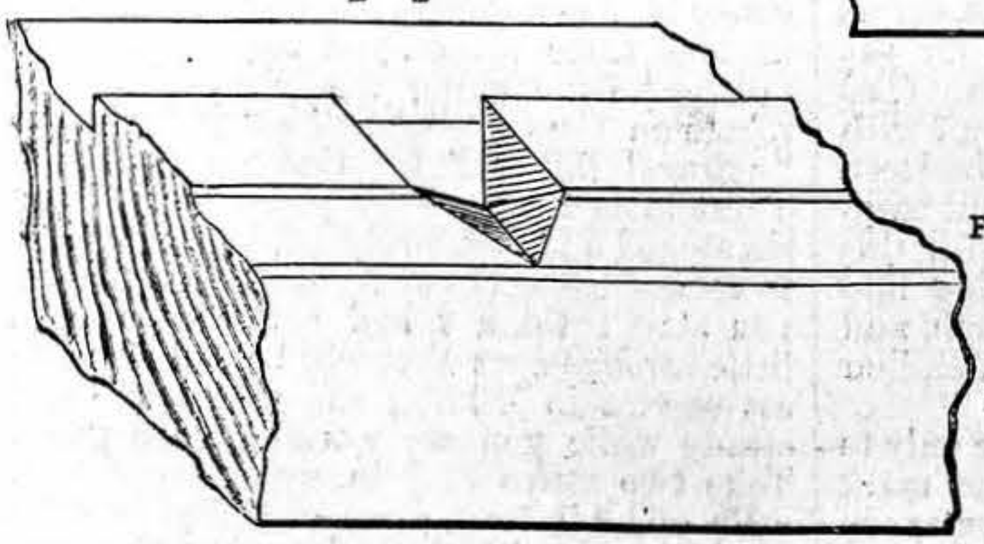

Fig. 16.—Mortise and Mitre for Bar in Framing.

Fig. 13.—Shape of Wedge.

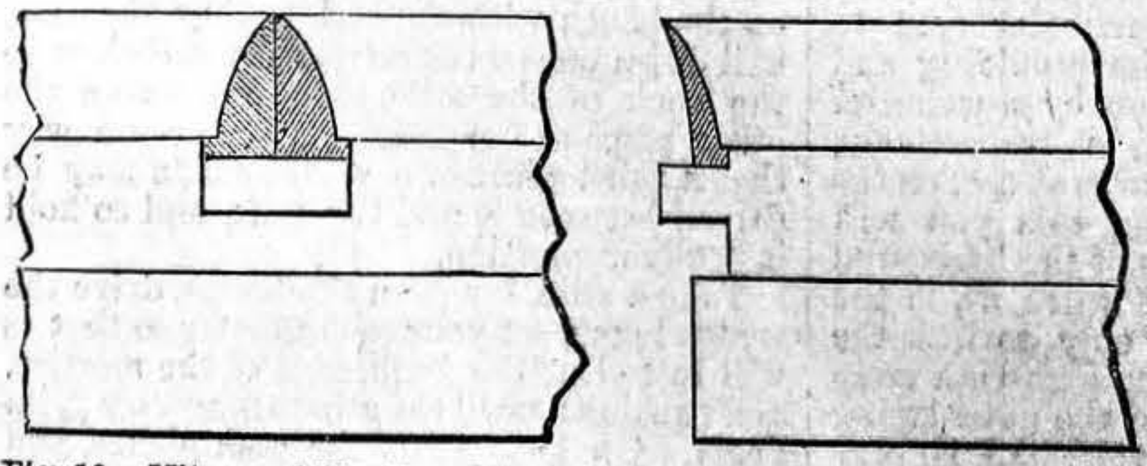

Fig. 10.—Mitre and Mortise of Vertical Bars.

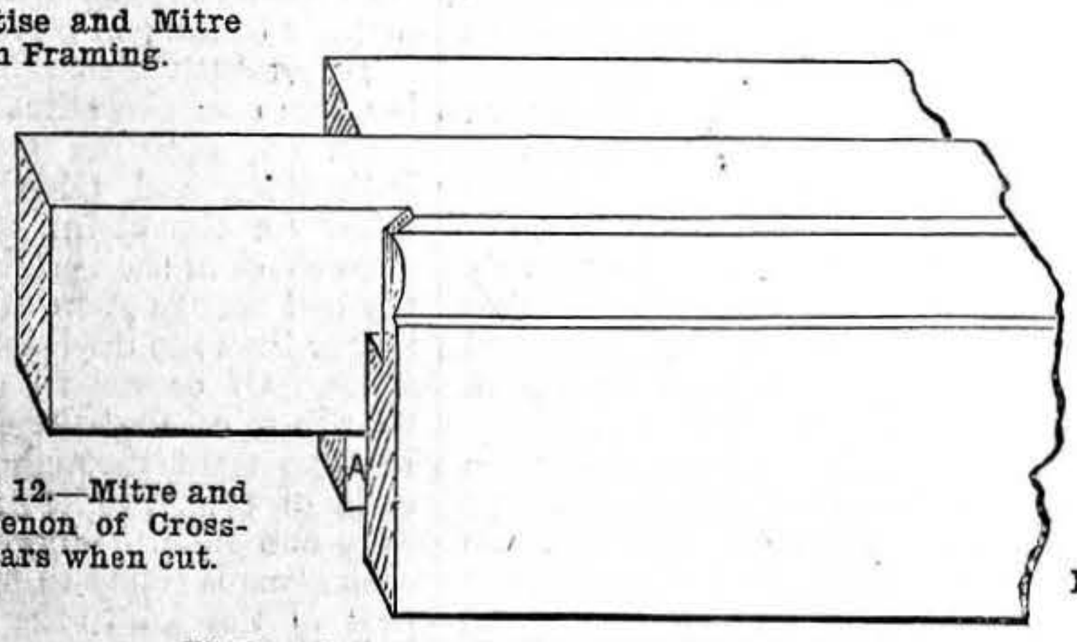

Fig. 12.—Mitre and Tenon of Cross-bars when cut.

Fig. 8.—End of Rail, showing Mitre, Rebate, etc.

SOME LESSONS IN WINDOW MAKING—GREENHOUSE SASHES.

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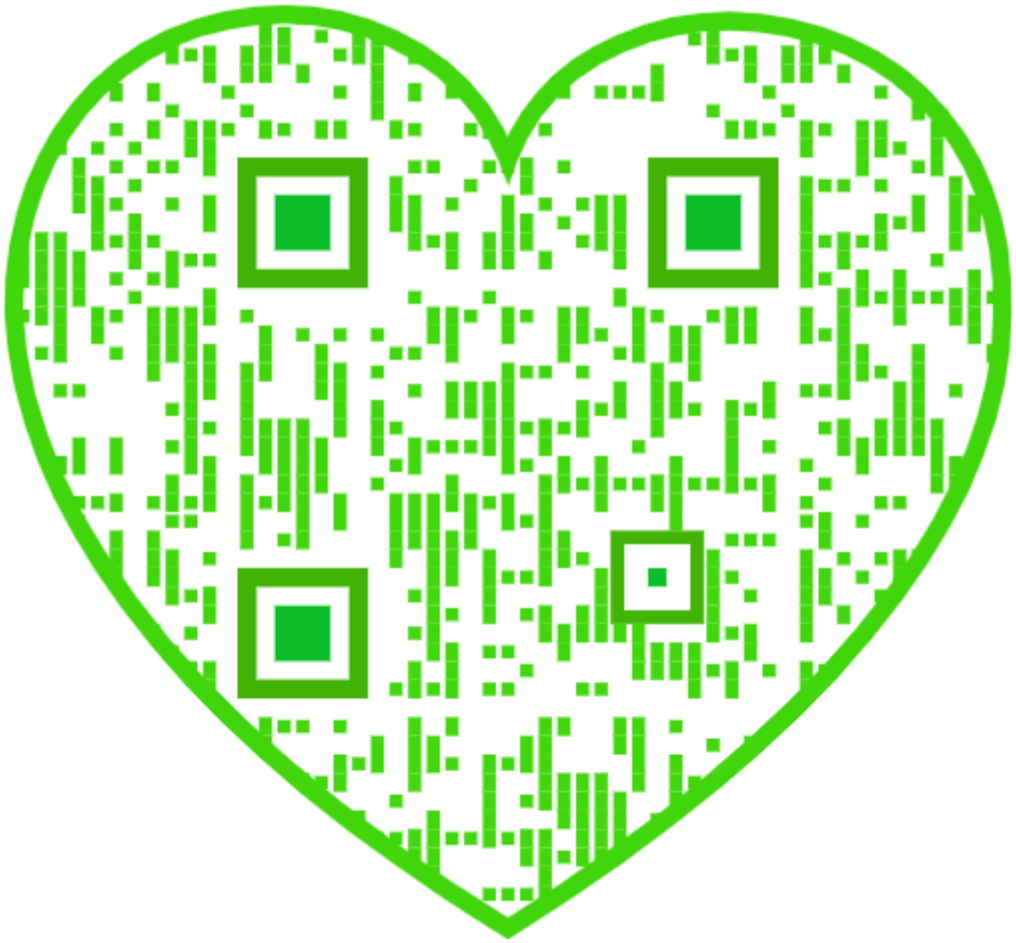

SOME LESSONS IN WINDOW MAKING.

BY G. LE BRUN.

GREENHOUSE SASHES OR DEAD LIGHTS.

AMONG the many and varied jobs undertaken by the average worker in wood, that of sash making seems at first sight to present the most difficulties, and very few amateurs in the art of carpentry ever attempt the putting together of even a simple form of window-sash; while the young professional, during his apprenticeship, considers himself almost fully fledged when he has mastered the subtleties of setting out a hung window and fitting together the cross-bars thereof.

Now, there is very little mystery in the matter, and no reason why the worker whose head is clear enough to overcome the difficulties attaching to dovetailing, mitring, mortising, and tenoning, should not grasp, by the aid of a few plain instructions and drawings, the art of putting together a window-sash. To those amateurs who go in for greenhouse building or for the making of forcing-frames, the knowledge of how to construct their own sashes will be of much service, for it is within my own knowledge that many clever workers in wood are deterred from working in this direction from their inability to put together the requisite framing.

Premising, then, that the aspiring sash maker has already overcome the difficulties of mortising and tenoning, and can use his tools fairly well, I will endeavour to clear his path for the making of his first sash, which shall be of a simple form, and of the appearance shown at Fig. 1. The wood used for the first attempt should be clean yellow pine. This wood is not in general use for sashes that are to stand much wear and tear—red pine, pitch pine, oak, and sometimes mahogany and teak, are used—but for ease in working, if the worker can choose his wood, by all means let it be yellow pine.

For the window before us, which measures, over all, 3 ft. in height by 2 ft. 6 in. in width, there will be required two stiles, 3 ft. 3 in. by $2\frac{1}{4}$ in. by 2 in.; one top rail, 2 ft. 7 in. by $2\frac{1}{4}$ in. by 2 in.; one sole rail, 2 ft. 7 in. by $3\frac{1}{2}$ in. by 2 in.; two sash-bars, 3 ft. 1 in. by 2 in. by $\frac{5}{8}$ in.; and two sash-bars, 2 ft. 4 in. by 2 in. by $\frac{5}{8}$ in. Plane up all the stuff very accurately, and gauge the width and thickness of each piece to a shaving, as upon the accuracy of the preparing of the stuff much of the success of the finished sash depends; especially is this so in the thicknessing of the sash-bars, and to get them right you should run the double template, supplied with your sash-planes, along the edges of each; when the template will fit tightly all along the length of the bar, the thickness is correct.

In planing up the stiles and rails, the face and edge of each must be planed so that the grain of the wood runs in the same direction (this is illustrated by the arrows in Fig. 2), and marked with pencil, so that they can be easily recognised. The object of getting the grain of the wood to run thus is that the glass check and sash-plane may work freely and clean along the framing, as, if either side or edge ran the wrong way, the wood would be almost certain to tear up in splinters when working these planes.

Having got the wood all prepared, you can now proceed to "set out" your sash. To do this, lay the two stiles on the bench, the marked sides outwards and the marked edges uppermost (Fig. 2). See that the ends are flush, and with a small square draw a line across the top edges of the stiles $1\frac{1}{2}$ in. from the left-hand end (A, Fig. 2). Measure off from this line 3 ft., and square across as before (B); these two marks are the exact height of the finished window; the $1\frac{1}{2}$ in. of over-wood at each end is not cut off until the sash is finished and ready to fit in its place. Technically, they are called "stumps," and they serve to prevent the splitting of the stile when mortising and wedging up. From the marks which you have just made measure inwards the thickness of your rails, which will be at the top $2\frac{1}{4}$ in., and at the bottom $3\frac{1}{2}$ in. (C, C). Again, measure from the outer top mark, $\frac{7}{8}$ in., and from the outer lower mark, $1\frac{1}{4}$ in., and draw lines across (D, D). Square across the marks D, D, C, C, and draw them on the under edges of the stiles, drawing additional lines $\frac{1}{4}$ in. to the outside of each; these outer lines are those you work to at the back of the mortise, which is tapered towards the front edge, as shown by the dotted lines in the figure. This taper is to allow for the insertion of the wedges that hold the framing together when completed. Before turning over the stiles to draw these marks on the back, you will require to set out the mortises for the sash-bars on the upper edge. To do this, divide the distance between C, C, into three equal parts, drawing your lines across for a mortise $\frac{5}{8}$ in. long; these mortises do not go through the stile, but are 1 in. deep, and in making them, if you have not got a mortising machine at hand, the best way is to bore a $\frac{1}{2}$ in. hole with a centre-bit, and then square the mortise up with a $\frac{1}{2}$ in. chisel. Work accurately to your marks, as if these mortises are too wide, the sash-bars will fit in a loose and shaky manner. And here I would remark that in setting out sashes, or other work requiring accuracy of workmanship, you must avoid using a pencil to square off your marks, and use a drawing-knife instead; otherwise, your work will never be satisfactory or workmanlike.

Having set out the stiles, the rails will now occupy your attention. Lay them on the bench in the same way as before, putting a piece of wood under the narrow one to bring its edge level with the wider one. Draw a line across, $\frac{1}{2}$ in. from left-hand end, as A, in Fig. 3. Measure off 2 ft. 6 in., and draw the line B; draw the lines C, C, $2\frac{1}{4}$ in. inside of the outer marks, the lines D, D, $\frac{3}{16}$ in., and E, E, $\frac{5}{16}$ in. from C, C. Square D, D, across the back of each rail, and E, E, across the face; these marks are cut in for the shoulders when you come to tenon. (See Fig. 4, which shows the end of the rail with tenons cut.) Divide the length between E, C, into three equal spaces, and set out sash-bar mortises as in the stiles, but with this difference: that instead of only going into the wood 1 in., they go right through, and are tapered for the wedge-grip in a similar manner to the rail mortises.

To set out the sash-bars, you have only to lay them on the stiles and rails, and mark them off, squaring your marks across on both sides, and taking particular care to allow for the fitting to the moulding and glass check of the upright bars by squaring off the end tenons $\frac{3}{16}$ in. and $\frac{5}{16}$ in., respectively, longer than the daylight marks at C, C, on the stiles. Of course, in doing this you will bear in mind that the ends of the horizontal bars go right through the stiles, while the ends of the upright ones only go into the rails one inch. Where the sash-bars cross each other is likely to prove the most trying part of the job to the novice, and is very difficult to explain on paper, but by the aid of an illustration I will endeavour to make it plain. When you have marked the mortises on the sash-bars, and squared them across on both sides, divide them *exactly* in the centre, draw a line (A) across, then $\frac{3}{16}$ in. from the outer marks, draw other two lines (B, B). You must draw these lines on both sides of the bar, and a glance at Fig. 5 will show you their position; this diagram is full size, and also shows the markings of the mortise gauge. Your framing is now all set out, and requires gauging off for mortising. Fix upon the chisel you are going to use—it must be a $\frac{1}{2}$ in. one—and set the two cutters so that when they mark they just fit the width of the chisel; then set the head of the gauge $\frac{11}{16}$ in. from the inner cutter, and run it over the positions of the mortises and tenons, on the stiles and rails, and also on the bars. Be careful in running the gauge to work from the marked face of your framing, as if, by any chance, you mark off a mortise or tenon from the back, it will cause you some vexation when you come to put the window together. Take an ordinary marking gauge; set it so that it will mark *exactly* in the centre of the mortise on the bars, and mark off each with it; this centre mark is shown at C in Fig. 5. You have now to take a $\frac{1}{4}$ in. chisel and cut out these mortises with it, but carefully observe that in the upright bars it is the mortise next the front edge that is taken out, while in the cross-bars it is that next the back edge.

This may seem a little mystifying, but it will become quite plain to you when you come to put the framing together. The stiles and rails you will have no difficulty about, as they are mortised and tenoned in the usual way, which I assume that you have already mastered.

So far only the ordinary tools that are in daily use have been required for the work; now you have reached a stage when tools of a special nature must be brought into play (or shall we call it "work?"). These tools are a pair of sash-planes and templates; various shapes of mouldings are run on sashes, but the commonest, if not the easiest, is the "Gothic," and I will suppose that to be the style used in the present case. The templates supplied with the planes are two in number, and are used to guide the chisel in mitring and fitting the mouldings of the sash, the single template being used for the framing, and the double one, previously referred to, for the sash-bars. A $\frac{5}{8}$ in. sash gouge is also requisite for this fitting work. Besides these planes, you require a "sash fillister" for making the glass check or rebate on the framing, and a "sash-bar," or "astragal fillister," for that on the bars. These tools having been procured, and well sharpened and accurately set, you are ready to commence work with them. But before you start I think I had better describe a little arrangement that will be of the greatest service in holding the pieces of wood steady while you are working upon them. Take two strips of $\frac{5}{8}$ in. wood, about 2 in. wide and 3 ft. long, place one of your stiles on the bench with the end against the stop, nail down one of the strips of wood close to the back of the stile, then nail down the other piece at the front, but in such a way that a third piece of a wedge shape may be driven between it and the stile, and so hold it firmly in position.

Take a stile, lay it on the bench, drive the wedge home, set your sash fillister so that it will just clear the back edge of the mortise, and run down until the rebate is *exactly* $\frac{3}{16}$ in. deep. On looking at the sash-planes, you will find them marked 1 and 2. No. 1 is used to run down with, and No. 2 takes off

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a shaving or two more, and puts a finish to the moulding; thus you will see that you may let No. 1 take off a moderately thick shaving, but No. 2 should be set very fine, and kept as sharp as possible. It is best, before running No. 1, to take off a shaving or two with the jack-plane from the sharp angle of the wood, otherwise No. 1 plane is apt to wear too much in the centre. Do the rails in the same manner as the stiles, and then take the bars in hand. For the bars you will require to make a wider wedge, so that you can secure them firmly on the bench, *back* edge uppermost; set your bar fillister so that it will form a rebate of equal depth on both sides of the bars, and run it down till it is of the same depth as the rebates on the framing. Fig. 6 shows the sash-bar, in section, fixed on the bench and rebated.

To run the moulding on the sash-bar you will require to make a special apparatus of the nature shown in Fig. 7, where it is shown in full size. The easiest way of making the back or grooved piece is to form it of three thicknesses of wood and fix it to the lower board, which should be of 1 in. wood, with screws. The back piece should be put on so that when the bar is in its place its front edge will be flush with the front edge of the board, along which the fence or guide of the plane has to work. Fix this "running board" to the bench with a screw nail at each end, place the bars on it, and run the planes, first on one side, then on the other, taking particular care in running down the second side to hold your planes very steady, as when you run down without caution you are almost sure to spoil the front edge of the moulding where it merges into that of the other side.

All the rebating and moulding being done, you can begin to mitre and fit together. Take the rails first, and with the single template mitre the moulding at each end, keeping the template to the innermost of the three marks (C), which is still visible on the top edge. After mitring, take the sash, gouge and cut down about 1 in., clearing the corner next the tenon with a narrow chisel; turn over the rail, and with a ½ in. chisel cut down a groove $\frac{5}{16}$ in. deep on the end of the rail till it meets the tenon (A, Fig. 8). This groove is to allow of the fitting in of a corresponding projection on the stile which serves to steady the joint. Fig. 8 is a drawing of the end of a rail, showing the way in which the fitting as described is done.

The stiles are then taken, and with the template the "list," or small piece that is between the mortise and the moulding, is cut down to where it touches the top part of the moulding, and ¼ in. from that the moulding is cut down on the bevel, and the piece taken clear out to the end of the stile. It is almost impossible to describe in writing the mode of doing this, but a study of Fig. 9 will show how it is done, and in practice you will easily comprehend the way to do it.

The two upright sash-bars are now mitred, using the double template. Let the mitre come clear to the outer edge of the moulding, and if correctly done from both sides of the mitre the cuts should meet exactly at a point, but leave a little wood towards the inner side, to prevent the bar breaking (Fig. 10). Mitre the ends as in Fig. 11. Take the cross-bars, cut each of them into three pieces exactly through the centre mark (A) on the mortise, and mitre the ends, as in the other bars. Fig. 12 is the end of a bar cut and mitred for the crossing.

Run a fine hand-plane along the flat piece between the mouldings and rebates on each of the pieces of your sash. One shaving is enough, as it is merely to give a clean appearance to the job, which, no doubt, will have a few finger-marks about it; and nothing looks worse on a piece of new woodwork than finger-marks—in fact, they stamp the worker as a sloven; and I have been in shops where, if a finger-mark was found on a job when it left the bench, a severe wigging from the foreman was the result, with perhaps the sack, if the workman persisted in leaving the "marks of the beast," as they were called, on his work.

Plane up a piece of wood, ½ in. thick, and cut out of it some wedges. You only want sixteen, but you had better cut a few more, in case of breaking any in the driving. These wedges should be about 3 in. long, ½ in. wide at one end, tapering to ⅛ in. Put a point on them with a chisel (Fig. 13). Be careful to cut your wedges square, as if they are not cut fair, they are apt to twist in driving, and will split the framing. Make also four round pins, $\frac{5}{16}$ in. diameter, and you are ready for cramping up the sash, for which purpose clear everything off your bench, and lay two pieces of wood across it. The size of these pieces is immaterial, but of course they must be longer than the sash is wide—about 3 in. by 1½ in. stuff is a suitable size. See that they are out of twist with each other when lying on the bench; if they are not, you must level them up until they are, by putting pieces of wood under the ends where required. If these bars were lying twisted, your sash would be twisted when cramped up.

Put the long sash-bars into their places in the rails, then put on the stiles, not driving them close up until you insert the pieces of the cross-bars. When they are in place, knock the stiles close, and lay the window on the pieces of wood on the bench, cramping up the joints with a joiners' bench cramp, and using thick white lead on the tenons and wedges instead of glue, which is unsuitable for work that is exposed to the influences of the weather. The stiles should be cramped up and wedged, and holes bored through stiles and tenons about the position marked A on Fig. 9. Into these holes the pins should be driven, after dipping the points in white lead. Now turn the sash and cramp up and wedge the bars—they do not require pinning. In doing this, you must be careful not to squeeze too tightly with the cramp, or you may bend or break some of the bars. Just put on enough pressure to bring the joints well together, and drive the wedges in evenly at each side, to avoid twisting the bars.

Two things must be attended to in the operation of cramping up. One is that the cramp must be applied in such a way that the stiles are not twisted up or down from the rails. If you apply the cramp too low you will twist them downwards; if too high, upwards. To avoid this, try a straight-edge, or the back of a square, across stile and rail, and raise or lower your cramp as required. The other matter is the keeping of the sash perfectly square while cramping. This is best done by trying it across from corner to corner (diagonally) with a rod. When the distance between the opposite corners is exactly the same, the sash is square, and care should be taken to keep it so while cramping.

Cut off the projecting ends of the wedges and pins, and plane up neatly on each side, being careful when doing the outside not to break away the thin piece between the rebates on the bars. Your sash is now finished and ready for fitting into its place, until which operation it is best to leave on the stumps of the stiles, and cut them off when doing the fitting.

When you have made a sash similar to that described, and mastered the little difficulties and intricacies of the various joints and mitres, you will have learned a valuable lesson, and one that will enable you to attempt with a greater chance of success the more intricate forms of windows.

The greenhouse builder, whose requirements in the way of sashes do not often include those with cross-bars, can, by following these instructions, and leaving out the horizontal bars, construct his side-lights to whatever dimensions he may choose; while in another paper I will endeavour to show him how to make his roof-lights, they requiring a different treatment in the matter of the sole, to allow of the water running off.

In common greenhouse work the use of the sash-planes may be dispensed with, and the inner edge left square, or chamfered. Of course, in leaving square edges you will have to allow for them in cutting the shoulders of the tenons, so that the marks C, C, in Fig. 3 will be those to square over on the face side of the rails for the shoulder.

When a number of sashes of the same size are to be made at one time, all the stiles may be laid on the bench, and set out at once by squaring across your marks on the top edge, then turning over and squaring them across on the back. While setting them out in this way, a sash cramp is generally employed to hold them together and prevent slipping, and also to aid in turning them over. The top edges of the rails are squared over in the same way, and the bars, if any, are held by two sash-cramps, and not only marked off, but shouldered and tenoned at one operation, after which the cramps are taken off, and the mortises squared over and worked out. This method saves much time in dealing with the various pieces singly.

In closing these brief instructions, I would again urge upon the worker the necessity for exactitude in all his manipulations—let him go slow until he is sure of his ground, and has quite mastered the details of the work. Applying the words of an old joiner I once knew, let him "First learn how to do a thing thoroughly, then—but not till then—how to do it quickly."

HOW TO MAKE A WEATHER GLASS.

BY J. GEO. LISTER.

INTRODUCTION, REMARKS ON MERCURIAL BAROMETERS—PRINCIPLE OF THE GLYCERINE BAROMETER—APPARATUS REQUIRED—DETAILS OF CONSTRUCTION—FITTING UP—USES.

THE mercurial barometer, though the most perfect instrument of its kind, and therefore the one deservedly used as a standard instrument for measuring variations of atmospheric pressure, is by no means an instrument easy of construction by an amateur. In the first place it is very difficult to procure glass tubing, which, whilst being of the requisite cheapness, shall be at the same time both strong enough and of sufficient equality of bore throughout. Again, it is one thing to fill a tube with mercury in an ordinary way, it is quite another to so fill a barometer tube with pure mercury that it shall contain no

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air; and, finally, no one but an expert knows what it means to make a glass tube "chemically" clean. The majority of persons who use a barometer do so for one purpose only—viz., to ascertain probable changes of weather in this very uncertain climate of ours. It will therefore be our purpose in this article to show how a "weather glass," but not a barometer, can be made which shall serve all the general purposes of the more expensive instruments.

It was discovered by Boyle and formulated by Mariotte, that when a gas is subjected to pressure, the volume occupied is exactly inversely proportionate to the pressure upon it—*i.e.*, if we increase the pressure we decrease the volume, and *vice versâ*. Now this law has been applied to obtain a knowledge of the state of the atmosphere by observing the changes of volume of a gas—*e.g.*, air in a closed vessel.

Now as to apparatus. We shall require the following, and appended will be found the average costs. Glass tube about 4 ft. long, and what is known as No. 3 cane, which is the size shown in Fig. 1. It has an external diameter of $\frac{3}{16}$ in.; cost, about 3d. A glass bottle of about 8 oz. capacity, cost, about 1d.; a composite candle, $\frac{1}{2}$d.; cork for bottle; a piece of paper, about 4 ft. long. This can be obtained at any draper's, gratis—it should be about 1 in. wide; a few magenta crystals, cost, 1d.; wood charcoal, 1d.; about one quarter of a yard of flannel, cost, 3d.; one piece of wood, 4 ft. by 1 in. by $\frac{3}{8}$ in., cost, 2d.; and about 2 ft. of $\frac{3}{8}$ in. by 4 in. timber, cost, 2d.; and, finally, 2 oz. of best glycerine, cost, 2d. Total cost, 1s. 3½d. For this amount we can make an instrument which will be of far more use as an indicator of coming weather than many a barometer costing more than twice as many shillings as ours does halfpence.

Now as to details of construction. Fill the bottle with glycerine about one-quarter to one-third, which has had one or two crystals of the magenta dissolved in it. This is to render the glycerine more readily visible. Next, thoroughly clean the glass tube. This can most readily be done by taking a small wad of cotton-wool and tying it in the middle of a string about 9 ft. long. Pass one end of the string through the tube and pull the wad through after it. Then reverse the operation. Do this two or three times and the tube will be found bright, clean, and *dry*, which is a great consideration. Next bore the cork, making the hole much less than the outside diameter of the tube. This can be done either by the careful use of a gimlet or a hot knitting-needle. The hole must then be enlarged until it is just smaller than the tube. Now push the cork carefully into the neck of the bottle, and having rubbed down the end of the glass tube on a little emery-paper, pass it with a gentle spiral motion through the cork and down into the bottle till the bottom end dips under the surface of the glycerine about $\frac{1}{2}$ in. Take next the candle, and, having lighted it, allow drops of the "wax" to fall all over the cork, and having heated a wire in the fire, pass it all over the cork so as to thoroughly melt the wax and allow it to run into the holes in the cork. Repeat, and when the cork will absorb no more, completely cover the whole lower end of the tube, the cork and the neck of the bottle with droppings from the candle. If this be properly and carefully done the tube will fit into the bottle quite air-tight. Now place the bottle on the floor, taking great care not to break the joint, and, having filled the *mouth* with air, blow a *few* bubbles into the bottle (see Fig. 2). Remove the mouth, and the air which has been compressed within the bottle will, to equalise the pressure, drive the glycerine about half-way* up the tube (Fig. 3). To make the scale, take a piece of the ribbon paper as long as the tube and divide it into 100 equal divisions, and gum this on to the strip of board of the same size, plus a small piece at the lower end where the wood scale is to fit into the box containing the bottle.

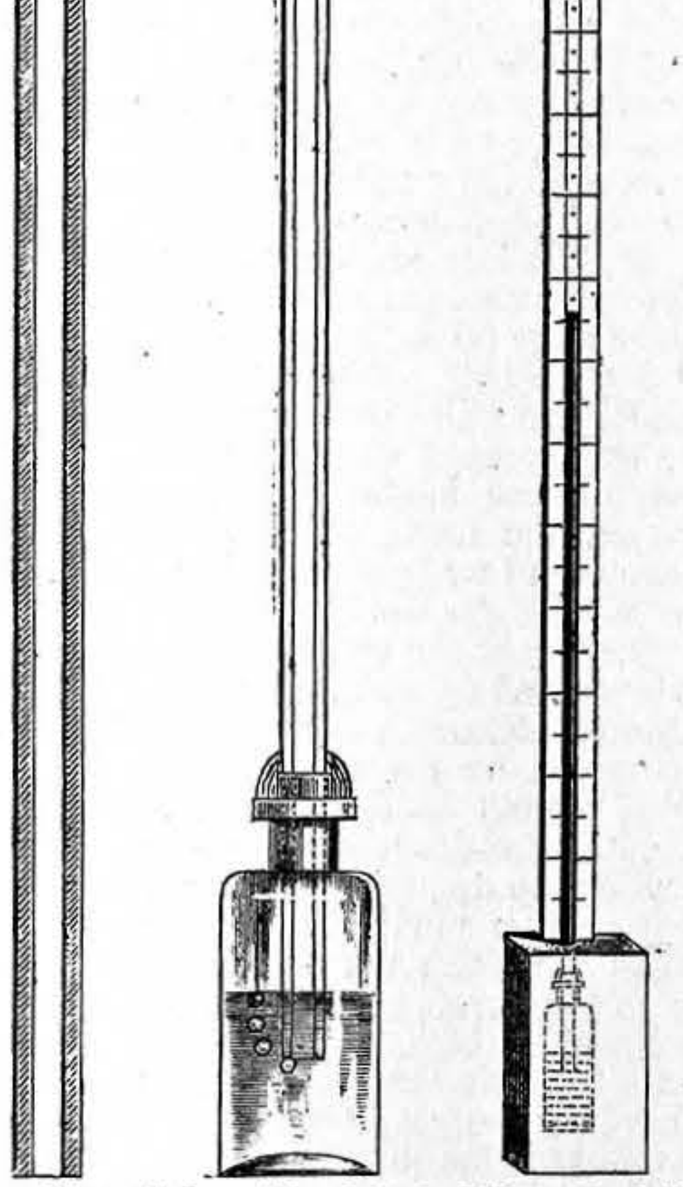

Fig. 1. Fig. 2. Fig. 3.

Fig. 1.—Glass Tube: $\frac{1}{8}$th of Actual Length, but showing Actual Diameter of Tube. Fig. 2.—Illustration showing Compression of Air and Method of filling Tube. Fig. 3.—Instrument Complete with Scale and Box.

Our next proceeding will be to arrange for the protection of the bottle from atmospheric changes of temperature. This is done by cutting the flannel into strips about 1 in. wide, stitching these into one long strip and binding this closely round the bottle spirally from top to bottom. Now make of the remaining timber a small box about 3 in. square and 2 in. longer than the bottle. Place in the bottom of this a mixture of coarse sawdust and broken charcoal in a layer about 1 in. deep, and on this place the bottle. Fill up the box with the same mixture, completely covering the cork. Fix the scale with its back into the lid and slip this over the end of the tube and secure the top with screws—not nails, as these might cause the joint to "spring." Secure the tube to the scale by one or two small staples or pieces of wire.

Finally place on the top of the glycerine in the tube a drop or two of paraffin oil; this will effectually prevent the glycerine absorbing water from the air, which it is very liable to do, and loosely close the end of the tube with cotton wool, and our weather glass is complete.

To Use.—Place the "glass" on a bracket (in some place where the sun does not shine, and where the temperature is fairly constant) about 3 ft. from the floor, and carefully observe its behaviour for a few days. It will be found on the approach of a change in the weather, and hours before a mercurial barometer show any indication, that the glycerine begins to rise, often several inches, indicating wet or wind; or fall, indicating fair weather. After a few days' comparison with itself the glass will be found one of the most faithful of "weather prognosticators."

* When "setting" the glass it will be advisable to consult a mercurial barometer—one of the many public ones suffices, or the weather reports in any newspaper—and if the mercury stand very high, the glycerine should be made to stand low, and *vice versâ*.

WIRE-WORK IN ALL ITS BRANCHES.

BY JAMES SCOTT.

Rat-traps.

No one will feel inclined to deny that of all the pests, the torments, and depredations of which we are frequently exposed to, rats must be classed as the most formidable. Man's ingenuity has been called into exercise to endeavour to eradicate this nuisance, and the devices, passing under the general name of rat-traps, are numerous and various. The commonest pattern is the one which I have taken for our consideration, and is shown in Fig. 94 (see page 485). Some may say that this kind of article is falling into disuse, because the vermin which it is most desirable should lose their liberty by its aid are possessed of sufficient intelligence or reason (although some would try to assure us that it is but instinct) to foresee the calamitous results of their entering the "freehold" construction, and endeavouring to extract the delicate (?) morsel from the interior thereof. But, withal, it is an exceedingly useful trap; and, in addition, it is comparatively cheap to purchase, and it will not be found difficult to construct by anyone desirous of so doing, who will give his attention thoroughly to my detailed description of it.

Referring to my above remarks on its usefulness, I must say that when introduced for the first time among a colony of these detestable creatures, it may safely be relied upon that a few at least will be captured. This is decidedly most advantageous; for rats are, I am given to understand, very prolific, and consequently increase immensely in numbers in a comparatively short period. I will now press forward to the particulars of their manufacture—not of the rats, but of the traps.

A long strip of tin, or other metal, has a number of holes through it. It is fixed to the bench by being stapled, or secured in some other manner, one end of it being on the left-hand side of the worker, and the other end at the right-hand side. Three of the holes are rather larger than the

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remainder, for certain reasons which will be made clear to the reader in my future remarks. This simple appliance is called a slide, and I have spoken of it in a previous paper.

In beginning a trap of the size noted in Fig. 94, the wires are laid as shown in Fig. 95. These are supposed to be laying horizontally. The front end of each of them is bent into the form of a hook. The tenth, twenty-fifth, and thirty-fifth wires, counting from the left-hand side, must be of a stouter gauge than the remainder. They are afterwards bent in certain ways; but I must first name their parts. A and C will be the sides; D will be the top; the larger part of B will be the bottom, while the smaller portion of it (that which is above the remainder of the wires contained within the space F G—Fig. 95) will form one end. One end will be left open to receive the door. All these wires are then placed through the respective holes in the slide. I do not show this stage of the process in any of my diagrams, as a drawing would appear but a confused mass of lines; therefore I must ask the reader to follow my description as closely as he can.

These wires, then, are pushed through the holes, allowing but the hooks and a portion of the wires adjacent to the latter to project in front of the slide. Upon them is afterwards placed the frame. I will proceed to describe this. It is shown in Fig. 97, and consists of five wires of sufficient length each to cover the whole of the wires in portions A, B, C, D (Fig. 96), and each parallel to the others and at equal distances apart, with hooks at their right-hand ends. They are turned over on to a bar at the left-hand side.

The lower wire of this frame is laced to the whole of the wires upon which it rests (Fig. 96) at a point just above the hooks. It, when this is completed, is drawn exactly underneath the front hooks, naturally carrying frontwards the other four wires composing the frame, and the front hooks are then squeezed over on to it. Of course, it will be seen that it cannot conveniently be fixed under the hooks, and there laced, in the first instance.

The work at this stage is drawn further frontwards through the slide, and the second wire of the frame laced in its position. The third, fourth, and last wires are similarly treated, care being taken that they are laced exactly parallel to each other. These operations should bring the last wire of the frame within a short distance of the ends of the wires in portions A, C, and D (Fig. 96), which latter are then turned over on to it in the usual way.

Thus far, the work appears as in Fig. 96. The bending now takes place. It is still supposed that the work is laying flat upon the bench. Portion A (Fig. 96) is then bent upwards into a perpendicular position, and portions C and D are also bent thus both together (Fig. 98). Portion D is still further bent, in a horizontal direction this time, bringing its exposed side against the exposed side of portion A (Fig. 99). It will be now understood for what reason the hooks are upon the right-hand end of the frame (Fig. 97). They are, of course, brought, by this bending process, close up against what was the exposed side of portion A, over which they are then turned and squeezed down. The final procedure to complete the skeleton of the trap is the bending upwards of the wires in the further part of the portion B, which have all the while been laying horizontally, bringing their ends in direct contact with the end of portion D, over which they are then turned. Therefore, the wires composing this part of portion B must be in length, when they are turned over, equal

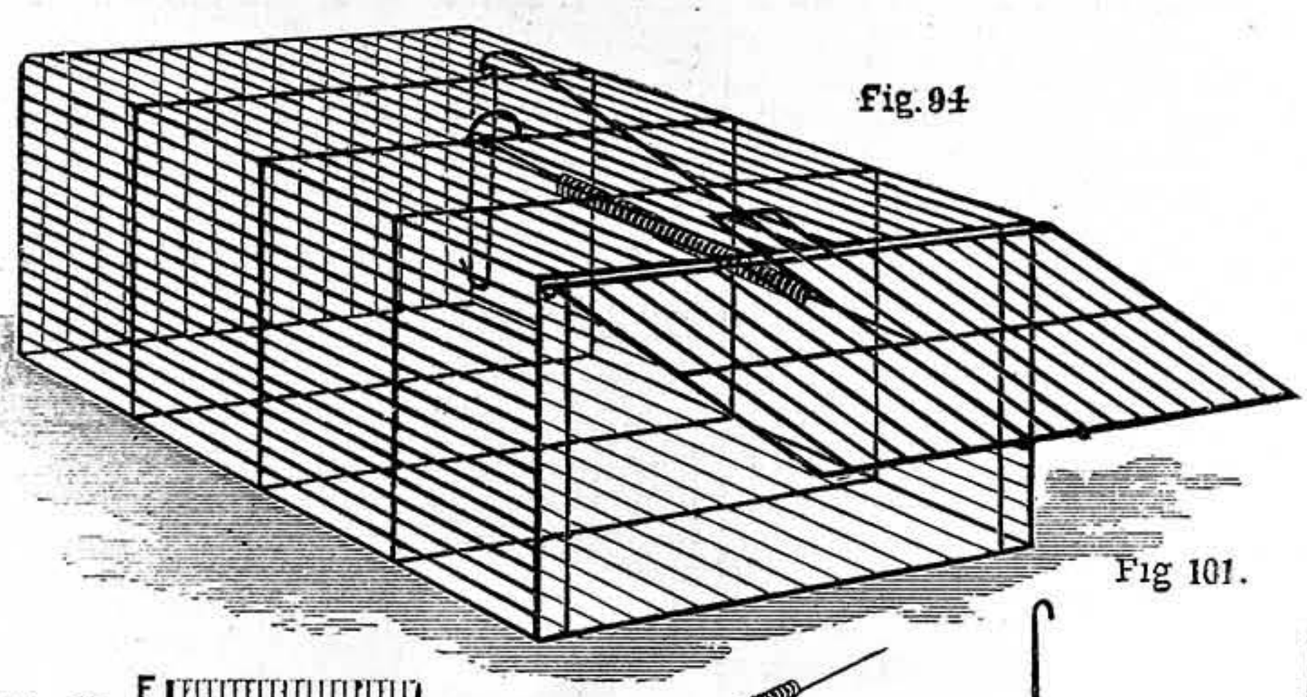

Fig. 94.

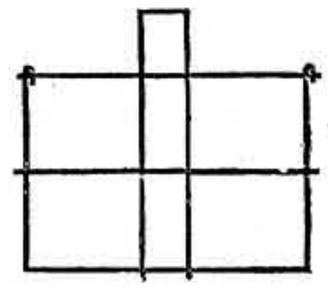

Fig. 103.

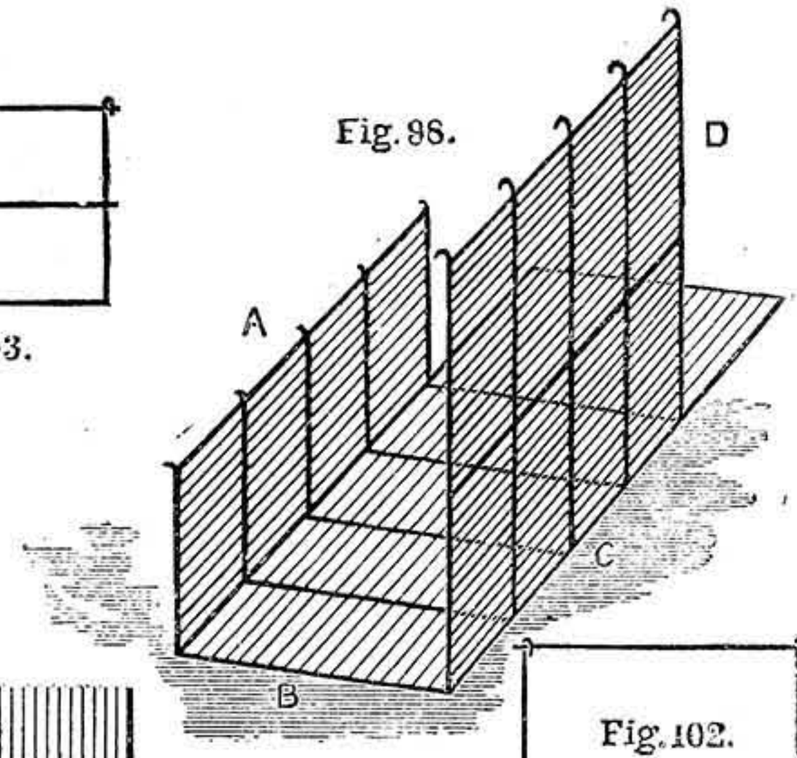

Fig. 98.

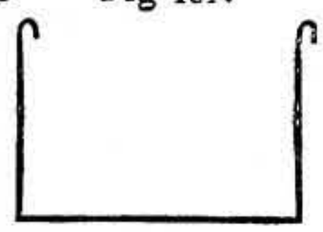

Fig. 101.

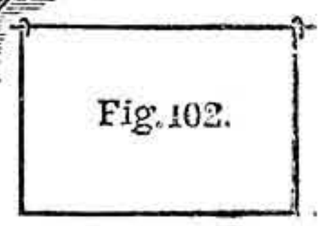

Fig. 102.

Fig. 110.

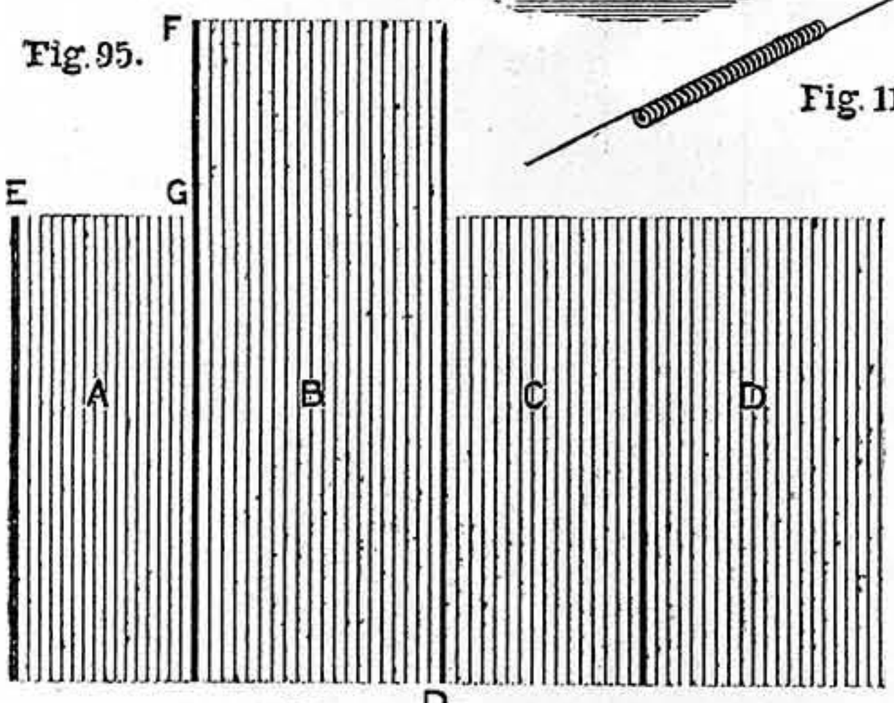

Fig. 95.

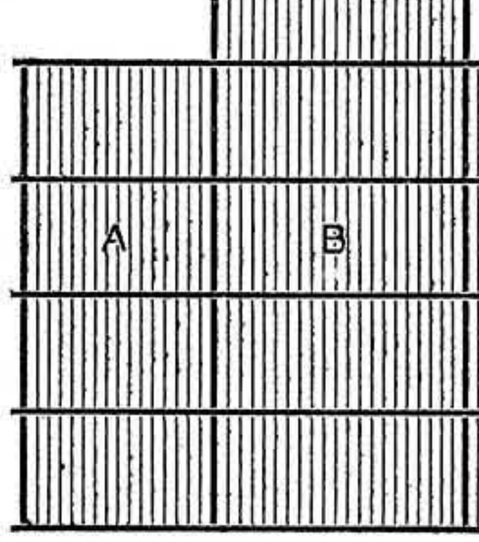

Fig. 96.

Fig. 104.

Fig. 105.

Fig. 108.

Fig. 106.

Fig. 107.

Fig. 109.

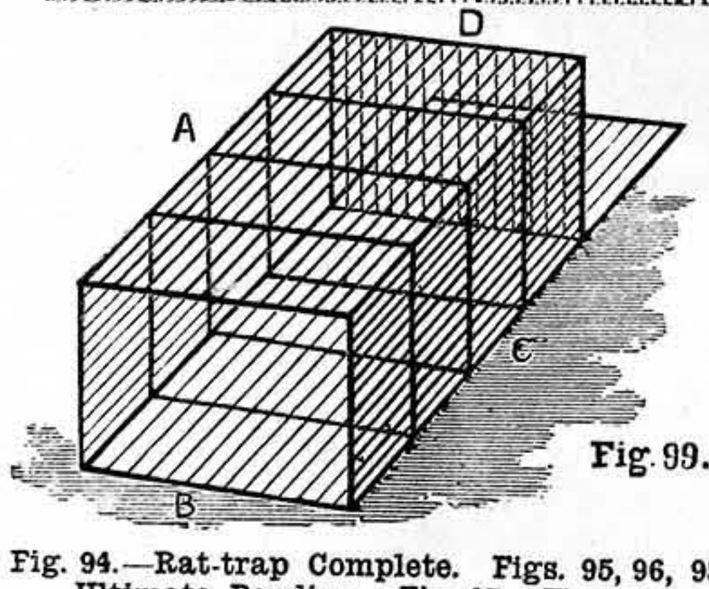

Fig. 99.

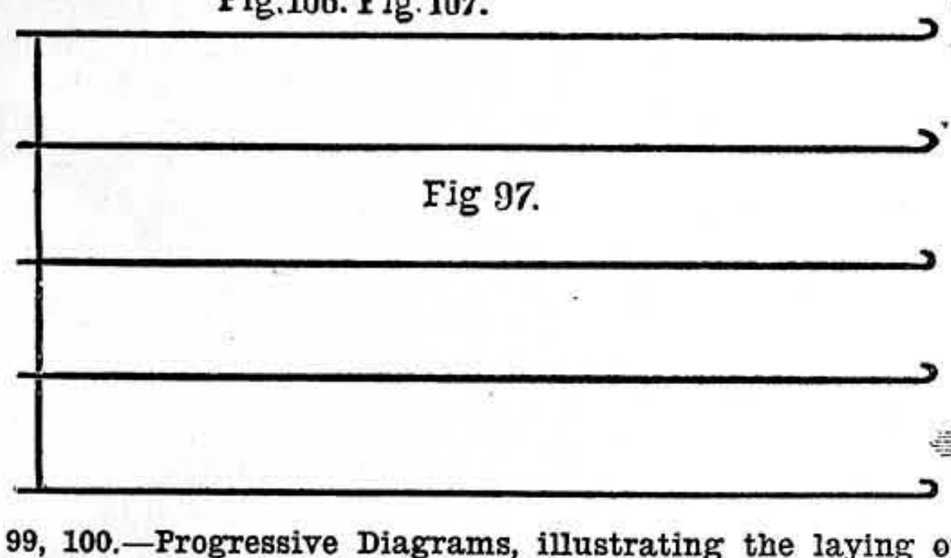

Fig 97.

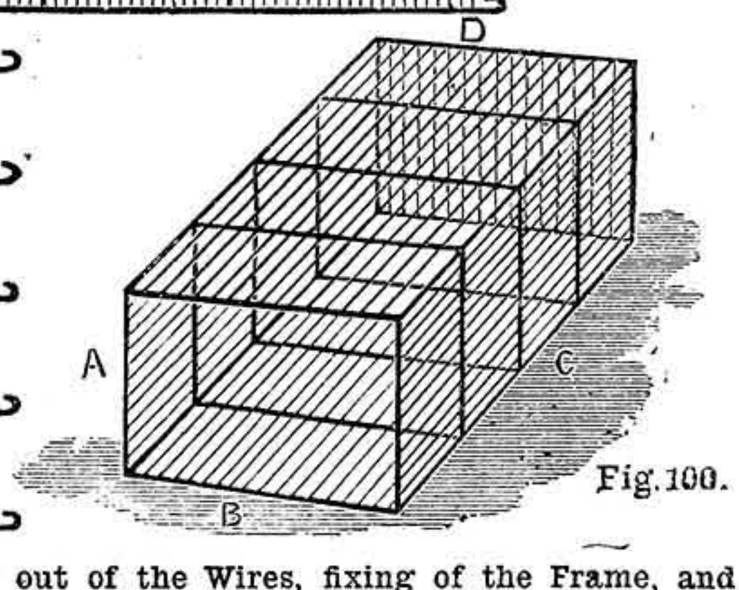

Fig. 100.

Fig. 94.—Rat-trap Complete. Figs. 95, 96, 98, 99, 100.—Progressive Diagrams, illustrating the laying out of the Wires, fixing of the Frame, and Ultimate Bending. Fig. 97.—The Frame. Figs. 101, 102, 103.—Progressive Diagrams, illustrating the Construction of the Door. Fig. 104.—The Bait-hook (Side View). Fig. 105.—The Bait-hook (Front View). Fig. 106.—Bait-hook with Link Wire (Fig. 108) attached. Fig. 107.—One of a Pair of Drop Wire Runners for Front of Cage. Fig. 108.—The Link Wire for Bait-hook. Fig. 109.—Handle. Fig. 110.—Spring.

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to the width of each of the portions A and C separately. What I mean can be seen by a glance at Fig. 95; the part F G must be a trifle longer than the part E G, the extra length being for purposes of turning over. To strengthen the end when thus far finished, a single bar is laced or tied upon the outside of it, across the middle.

The door is the next thing to attend to. For this a frame is made. I will deal with it as with the other parts—progressively. First there is a bent wire, as in Fig. 101, the hooks of it being supposed to be bent *away* from the reader, which can hardly be properly shown in a small sketch. Immediately underneath the hooks is a cross-bar, turned over from the front on to the sides of the first wire (Fig. 102).

In the middle, when thus far complete, is an upright wire, bent in a similar, but reverse, manner to that in Fig. 101, but being much narrower and a little longer than that wire when so bent. Previously, the required number of wires must have been placed in the slide in the same manner as the larger piece of work, having, likewise, hooks in the front. My foregoing instructions will apply equally to this part of the trap, the wires being laced and turned over on to the frame. I must mention, however, that two or three wires in the middle must be somewhat longer than the remainder, and be turned over on to the longer part of the frame. This last part is laced on to the rest when the lacing takes place, and a double stitch is usually given for purposes of strength, where the longer part of the frame comes in contact with the cross-pieces.

The fixing of a middle bar is the final performance to complete the body of the job. It is laced securely across the front of the door, and tends to strengthen it. The door, thus ready, is attached to the body of the trap by having its top hooks squeezed down over the front top wire of the body in such a manner that the door may work freely up and down. I will leave the fixing of the spring until last.

The bait-hook is the next part added. This is shown in Fig. 104. The top hook upon it is bent at right angles to the lower hook (Fig. 105). Through the eyehole is passed a small bent wire (Fig. 106), which latter has a hook at each end of it. The hook is then passed through the top of the cage, and the small wire (Fig. 108) secured to the middle cross-wire of it by means of its hooks being squeezed down upon it, and further by its being tied to the various wires it touches.

The handle is fastened to the same wire as that to which the bait-hook supporter is attached, but the latter holds the hook at a distance from the handle, and therefore in no way interferes with it. The handle is merely a bent wire with a hook at each end (Fig. 109), by which it is secured to the wire above-mentioned across the cage.

A single wire is bent over the long top wire of the door, outside, so that it may work freely, the further end of it being quite straight, as most people know. This wire, when its loose end is fixed under the bait-hook, retains the door as in Fig. 94, and the slightest movement of the hook displaces it, and consequently releases the door.

A drop wire is attached to the front of the cage, with the view of preventing any unpleasant rodent who may have been unfortunate enough to be entrapped from making his escape. Wires, shaped as shown in Fig. 107, are secured, one at each end, to the front of the body, in a direction continuous with the latter. Over these is slipped a wire, in length the same as the width of the cage, having an eyehole at each end, so that it may be easily moved upwards and downwards. When the trap is set with the desire of catching a victim, the drop wire is drawn to the top of the cage; and the reader will see clearly how, when the door has closed, the wire will drop to the bottom, over the front of the door, and preclude any possibility of its being opened from the interior by an occupant.

The process of springing is now reached. I have elsewhere described how to form a spring. A good strong one will be necessary for this work. One end is fixed to the second or third wire of the top of the cage, and the other end fastened to the cross-wire of the door. It must be in an unstretched state when this is done. Two springs, one at each side, might be fixed; but it is usually quite sufficient for purposes of strength to have but one.

Particulars as to sizes and gauges of wire used in connection with various articles I intend to describe will be given in another number. This will prove more convenient for the reader.

PRACTICAL PAPERS FOR SMITHS.

BY J. H.

THE WORKING OF STEEL—DIFFERENCE BETWEEN WROUGHT IRON AND STEEL — HEAT FOR WORKING — DIFFICULTIES OF WORKING — OVERHEATING — MODE OF HEATING — BLUE HEAT.

I AM now going to devote two or three papers to a very important and difficult section of the smith's art—namely, the manipulation of steel. There are larger quantities of this material used now than formerly. A good many questions appear from time to time in WORK relative to the subject. It is one that embraces a very wide range of operations; I shall therefore devote this article to the general consideration of the working of steel, and afterwards write in some detail on the special processes of welding, hardening, and tempering.

Wrought Iron and Steel Contrasted.—There is, as regards chemical composition, very little difference between wrought iron and some of the Bessemer and Siemens mild steels. But there is a very essential distinction between them when brought to the test of working. Wrought iron is not perfectly homogeneous; mild steel, like the crucible or tool steel, is of the same character throughout. This difference is due to the difference in the processes of manufacture. Wrought iron is never at any time during the process of its puddling in a state of absolute fusion. It is simply brought into a pasty condition, like a lump of dough. The fluidity of cast iron is mainly due to the presence of its carbon, and in a lesser degree to its sulphur. These are removed from the iron in the processes of puddling; and one important result is this of non-fusibility at the temperature at which it is found best to work it. In order to render this material, therefore, as homogeneous as possible, the pasty mass is hammered under steam hammers or tilt hammers, and is passed beneath squeezers of different types, is cut up again and reheated, and the operation of hammering, squeezing, and rolling repeated, the quality of the iron improving with each repetition of these operations. These sets of operations will be repeated three or four times in the case of good merchantable iron, and it is the cost of fuel and labour involved therein which renders wrought iron so much more costly than cast iron. After the last piling, re-heating, and hammering processes have been gone through, the iron is run between grooved rollers of diminishing sizes, to impart the final sectional forms to the bars or plates required for the use of the smith and boiler-maker. But it is because of the absence of fusion that even in the best wrought iron some of the oxide or scale, and some of the mechanical impurities originally present in the iron, or taken up in the process of puddling, become inextricably entangled with the bars, and remain therein, causing the iron to become spilly, and to develop incipient fracture when wrought into structures.

Lamination absent from Steel.—From this lamination the Bessemer and Siemens steels are free, for the simple reason that during the process of fusion all scale or oxide has been eliminated. And this is one reason why the mild steels have superseded wrought iron largely in boiler-makers' work, and in some smiths' work, especially cranks and similar structures, where lamination would be fatal to strength and durability. The best wrought iron can never be entirely depended on for absolute homogeneity. But for the average work of the smith it holds and must long hold its own, because of its ductility, weldability, and the general ease with which it can be fashioned into intricate forms.

Homogeneity of Steel.—Steel being homogeneous—that is, having no grain—is eminently adapted for the forging of light and delicate work, where strength, rigidity, and lightness are required in combination. It is therefore specially adapted for model work and for the finer portions of mechanism, and for those where strength is essential.

Heat for Working.—After the absence of fibre, the next cardinal difference between the working of wrought iron and of steel is this: that while wrought iron can be worked almost at the fusing point, steel cannot be worked beyond a full red heat. Moreover, each different sample of steel seems to work best at a particular temperature, differing from that of other samples.

Polish. — Another point in favour of steel is that it takes a much higher polish than wrought iron, and is therefore better suited to work where good finish is necessary.

Capacity for Hardening.—Steel owes its chief value, however, to its capacity for hardening and tempering. A regular gradation in hardness is thus obtainable, rendering it suitable for every possible requirement.

Capability of Working.—Whether steel is more troublesome to work than iron depends partly on the nature of the forging and partly on the quality of metal. For small model work, steel is by far the best, because there is no grain to open out, besides the facts before mentioned of superior rigidity, and so forth. In large and heavy forgings, on the other hand, there is no advantage to be gained on this score. In forgings, again, of moderate size and thin sections, on which a good deal of work has to be done, forging in steel becomes more expensive than forging in iron. For as steel has to be worked at a lower temperature than iron, a larger number of heats must be taken in the former than in the latter. For the same reason the various operations should be

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performed more rapidly while the steel retains its heat.

Capability of Welding.—There is more difficulty in welding steel than iron. But the difficulty is largely of an initial character, being due to the differences in separate samples of steel. Once the best welding heat for any bar of steel is known, then there is no more trouble experienced in welding pieces from that bar. Sand alone is used as a flux for welding iron; for steel a mixture of sand and common salt is better.

Opinions re Working of Steel.—There is not so much unanimity of opinion among workmen as to the working of steel as there is in regard to the working of iron. The practice of allowing steel to soak in the fire, approved by some, is denounced by others. The temperature to which steel can be raised without burning it is a matter of dispute. The practice of hardening and tempering opens up a vast and unlimited field for discussion. The reasons are not far to seek; steels vary much more in quality than wrought iron, and since the peculiar value of steel is due to most minute chemical and molecular composition, and as slight and sudden alterations in temperature are sufficient to entirely change their arrangement, it is easy to understand why, though not how, they should influence the practical working of the material. Partly, too, because of these differences and consequent differences in treatment demanded, are some makes of steel considered superior to others. Thus, a man may have been accustomed to work in one quality mainly, and having adopted certain modes of treatment of that with the best results, and finding the same modes do not give equally good results with another quality, he too hastily condemns the latter, when in reality the fault lies at his own door. It cannot be too strongly insisted on that every new bar of steel should be first worked tentatively, in order to discover the best heat and the best way to work that particular bar. Unless this is done, frequent failure to obtain the best results will follow.

Upsetting Steel.—The practice of upsetting steel is deprecated by some. But if the steel is of good quality it will upset just as well as iron.

Overheating.—Steel must not be overheated, or it will become burnt. But it should be made as hot as the metal will safely bear. A higher temperature can be used on steel required for large forgings than for steel used for cutting tools, and for light work generally. A piece of burnt steel will crumble to pieces under the hammer as though it were cast iron, and will show a coarse granulated fracture. There are, however, degrees in burning—it may be burnt slightly on the surface, so slightly that it does not fracture, or, if fractured, does not show this coarsely crystalline structure. Yet its quality for cutting instruments will, nevertheless, be sensibly impaired. The temperature at which overheating occurs varies, of course, with different qualities. If scales form and fall off, the steel is, as a rule, overheated. It is then almost impossible to restore it to its pristine quality. If not burnt very badly, a good hammering on the anvil will improve it considerably. There are also various physics employed by tool smiths. They mix various ingredients, and keep these by them for use. The following is one:—Mix together two parts of pitch, two of train oil, one of tallow, and a little salt. Plunge the metal at red heat into this two or three times in succession.

Mode of Heating Steel.—The smith uses the forge-fire for heating any steel for forging. For hardening and tempering he only uses the fire in the case of large work; small work is heated on a bar of iron first made white-hot in the fire, or special furnaces are used. The temperature of small pieces of work can be regulated better on a bar of iron than in the fire. When steel is heated in the fire the blast is put on very sparingly, and the heat also is kept as low as it is possible to forge at. Moreover, the steel is allowed to remain in the fire sufficiently long to become of the same temperature throughout, but "soaking," as the saying is, beyond this is dangerous.

Uniform Heating.—Steel, even more than iron, should be turned around in the fire to keep the heat uniform. The blast should be slackened after the edges have become red-hot. A full "cherry-red" is usually considered the proper heat for forging. But this expression is rather vague, and the temperature, as we said before, will vary with different qualities. Hammering should not be continued after the steel has lost its redness. It is injured by hammering at a blue or blue-black heat.

Blue Heat.—Smiths and boiler-makers know that there is a temperature in steel corresponding with what they term a "black heat"—a heat at which it is not safe to work it. A number of experiments have been made by the Steel Company of Scotland, and by Mr. Strohmeyer, upon steel in this condition, and they fully bear out and emphasise the rule-of-thumb knowledge of the practical man. At the works of the Steel Company of Scotland forty-eight plates were taken, and strips cut from each. Half the strips were bent cold to an angle of 180° round a bar of a diameter equal to twice their thickness, and all stood the test. Corresponding strips were heated in boiling tallow, and bent at that temperature, and everyone cracked before the bending reached 180°. Other experiments showed that a plate heated, and allowed to cool, suffers no diminution of strength, but that if while cooling, and during the period while it is at a blue heat, any hammering or bending is done, it will be found when cold to be seriously injured. Mr. Strohmeyer found that while a test strip bent cold would stand from twenty to twenty-six bendings before cracking, if it was bent once while at a blue heat, and allowed to cool, it broke afterwards with very few bendings. The blue heat corresponds with any temperature between about 470° and 600°.

In my next paper I shall write of the various classes of commercial steel, and of the art of welding the mild steels. A subsequent paper will be devoted to the hardening and tempering of the high carbon steels.

IMPROVEMENTS IN HARNESS.

BY J. C. KING.

Top Hame Fastenings.

THERE is plenty of room for improvements in harness, but they must come from users who know what is an improvement. Harness-makers, especially wholesale firms, stick to old devices and methods, so that their feeling is against anything that requires any extra supervision of work in a factory.

Doubtless it is the piece-work system of fixed prices and methods that has prevented many essential improvements being offered to the public in harness.

The present method of fastening the hames to horse-collars is by a strap, top and bottom, into two eyes to each hame, which hames may be described as the yokes of the collar to which the traces are fixed.

For pair-horse harness, chains are used at the lower ends of the hames, and a strap at the top of the collar to draw together and secure the hames in their places.

This seems to have been the plan for ages, and serves the purpose well.

In farm-cart harness it is a leather thong, which laces through holes in wooden hames. In waggon or van and town-cart harness, a buckle is used for the strap.

The same plan of a buckle is used in all pleasure vehicle harness, from the State carriage harness down to the costermonger's barrow harness.

In one essential particular it is unsatisfactory. The tail end of the strap is a loose

Fig. 4.

Fig. 3.

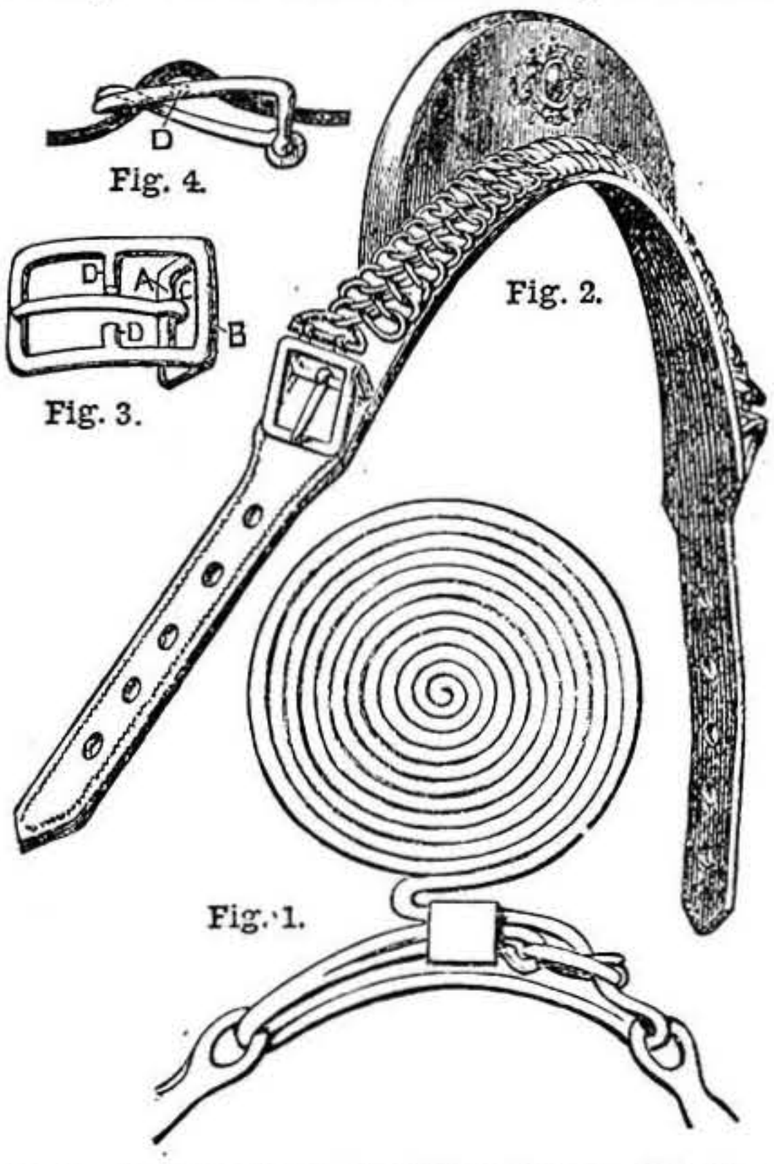

Fig. 2.

Fig. 1.

Fig. 1.—Four-in-hand Top Hame Strap. Fig. 2.—Read's Arrangement of Top Hame Strap. Fig. 3.—Improved Buckle seen from above. Fig. 4.—Ditto, Side View.

flapping point, that makes the harness look as if coming apart here.

The four-in-hand coachmen have tried to give a decorative turn to this point by winding the end of the strap into a miniature target, but it is apt to come uncoiled on a journey: it cannot be considered an ornamental device, as represented by Fig. 1.

The only successful plan yet adopted was patented by the late Mr. Thomas Read. This method in a simple way changed the upper strap into a combination of chain and strap, with two buckles instead of one; and the buckles were made in a peculiar form, with double heel-bars, by which the points of the ends of the straps were put out of sight under the chain when buckled up. Fig. 2 gives an idea of the buckles and the highly ornamental strap, with "housing" for monogram or crest. Although the article "Buckle" is not treated in some encyclopædias—and in one it is said that the buckle was introduced by Charles II.—discoveries in the ruins of Silchester have brought to light a buckle closely resembling the double-heeled one of the patent hame fastening. To ensure the

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effectiveness of this highly ornamental hame-chain, a special buckle had to be invented; without this useful security the hame-chain would be useless.

No form of buckle out of some 150 different sorts now made would serve the special purpose of holding at once a chain and a strap, and allowing the point of the strap to be hidden away somewhere; for, useful as is the point of a strap, it is not ornamental either coiled up or dangling up and down with the motion of a horse's shoulders.

Some old and prehistoric buckles were looked over in the museums of England and the Continent. They yielded interesting treasures for survey, but perhaps the most interesting were those excavated from buried cities and tombs, showing the advance in metal working ages ago: notwithstanding the absence of the word "Buckle" in some encyclopædias, and the assertion of one that they were brought into England as fastenings for shoes by Charles II.

The buckle-makers seemed to know less about the uses of buckles than anyone else. The difficulty was got over by having two heel-bars, as shown in Fig. 3, A, for the chain, and B for the strap, with a space, C, between to receive the strap point. How was the lower heel-bar, A, to be fixed to the strap without wrapping the leather round the bar, or sewing on an overlay piece, which would have limited the space for the strap point to enter? A sewing of fine copper wire through the strap and round the bar A made a secure job of it, and only took from the space the thickness of the copper wire.

All went together admirably, looked handsome, and realised the inventor's most sanguine hopes, till the hame-chain had to be unbuckled from the collar for putting away the hames and traces; then it was found difficult to get the strap point out of the bars of the buckle, as it was sunk below the buckle-frame, and could only be raised by the point of a knife, or a nail or hook.

The strap must be kept up in the frame high enough to allow the fingers to draw out the point easily. A middle bar is used in many buckles, and the tongue fixed on that bar, but in this instance it would not answer, so the device of a middle bar to uphold the strap point, with a gap in the middle to allow the tongue to lie down in the frame without taking the strap with it, was the plan devised. This is shown by D, D; and in Fig. 4 the buckle tongue is seen below the strap, and the strap above the frame at D, and answers well.

DESIGN FOR A VILLAGE SCHOOL TO ACCOMMODATE 180 CHILDREN.

BY J. HALL.

Introduction.—The school is intended for a large village; it comprises one large school-room and one class-room for the senior boys and girls, infants' school-room, with a gallery, master's room, cloak-rooms, and two sets of latrines (one to each sex), and boys' and girls' playground.

The school and class-room would be fitted up with dual desks on raised platforms, a dado of salt-glazed bricks four feet high, with a moulded capping in same materials, to run round all the rooms, etc.

The master's room, class-room, and infants' school-room would be fitted with cupboards for books, etc.

The cloak-rooms to be fitted up with post and rail divisions, and hat and coat hooks. The lavatory basins to be 13 in. diameter, and the sinks 2 ft. 6 in. by 1 ft. for washing slates.

The heating of the rooms, except master's room, would be by stoves. The master's room would have an open fire-grate.

SPECIFICATION OF WORKS (BRICKLAYER, ETC.).

Bricks for Facing.—The bricks for external facing to be the best hard, well-burnt, pressed red-facing bricks, laid in English bond; no bats to be used, flushed up each course, and to be neatly weather-joint pointed.

Common Bricks.—The bricks for internal facing to be the best hard, well-burnt common bricks from an approved yard, and to be finished with a rough surface to afford key for plaster.

Glazed Bricks.—The glazed bricks to be the best dipped salt-glazed bricks of approved brown tint, and to be set in fine mortar and pointed with Parian cement, and to have a cut joint.

Ditto for Urinals.—The glazed bricks for urinals to be best "seconds," as last.

Mortar.—The mortar to be composed of well-burnt stone lime and clean, sharp (river or pit) sand: proportions—three of sand to one of lime, to be well mixed and kept clean.

Concrete.—The concrete to be composed of an aggregate of five parts clean, broken bricks or stone, broken to pass through a 2 in. ring, and one part clean, sharp sand or fine gravel, and one part of ground lias lime from an approved maker, to be mixed by measure.

The floors of cloak-rooms to have a layer of broken brick or stone 6 in. thick, well rammed, and to have a layer of 2 in. thick of cement and fine gravel, two of gravel to one of cement; to be finished smooth with a coating 1 in. thick of fine crushed granite and cement, one coat to follow the other without allowing time to dry.

Drains.—The drains to be formed of best earthenware socketed drain pipe, jointed in cement, and to be properly disconnected with small chambers, with stone covers and grates in same.

Gauged Arches.—The arches of windows, doors, etc., to be formed of best red pressed wire-cut bricks, formed and set in cement on proper centering.

Arch Bars.—All fireplaces to have Gibbs' patent wrought-iron lintels, 2½ in. by ⅜ in., built 9 in. into the wall at each end.

Ventilation.—Fix Boyle's wall panel ventilators in all main rooms.

Flues.—All flues to be 14 in. by 9 in., and to be properly pargeted with cow-dung and hair mortar, a blank flue to be carried up each chimney-stack for ventilation.

Finish flues with a 1 ft. high strong fire-clay chimney-pot set in cement.

Latrines.—All the latrines to be fitted with automatic flushing closets.

Stonework.—All stone dressings to be of best quality, free from all defects, to be laid on its natural or quarry bed, and from an approved quarry.

Steps to be of Pateley Bridge or Bradford stone, sawn on top and edge and slightly chamfered.

Hearths to be of Bradford stone, sawn on one side and rubbed fine, laid solid on bed of mortar.

All stone to be worked in the best manner in every respect.

Sills to be checked, weathered, and throated.

TILER.—The roofs to be laid with best Broseley tiles to a 3 in. lap on 1 in. by ¾ in. sawn redwood battens, and each tile to be bedded in hair mortar, and nailed with two copper nails 1½ in. long.

Ridge.—To be of approved pattern bedded in mortar, and to match tiles in colour. All valleys to have purpose-made tiles to pitch of roof. All tiles to be laid double at eaves. Do all cutting, etc., required.

PLASTERER.—Plastering to be three-coat work. First coat of two of sand and one lime, with 5 lb. of cow-hair to one cubic yard of stuff; second coat to be three of sand and one lime, and to be finished with a coat of fine putty, trowelled smooth and left perfect.

Ceilings.—Laths to be "lath and a half" of riven Baltic fir, and to break joints every four feet; to be nailed with wire nails to ceiling joists; to have coat of hair and lime as before to walls, and floated smooth and skimmed with fine putty, which has been made at least one month.

Distemper.—All walls to have two coats, and finished to approved tint.

CARPENTER AND JOINER.—Best Dantzic Riga or Memel fir to be used for carpenters' work of an approved brand, to be full-grown and well-seasoned, free from sap, shakes, large, loose, or dead knots, and all defects.

The joiners' work to be constructed of best Quebec yellow pine.

Lintels.—Put lintels to all openings with 9 in. wall hold at each end and as many inches in thickness as feet in bearing.

Roofs to be framed as follows:—11 in. by 6 in. principal rafters, 10 in. by 6 in. tie beam, 9 in. by 3 in. purlins, 4½ in. by 3 in. spars, all framed in the most approved manner, with wrought-iron straps, bolts, etc.

Spars.—To be 4½ in. by 3 in., and not to exceed 12 in. apart.

Wall Plates.—To be 4½ in. by 3 in., and lapped and spiked at joints.

Platforms for Dual Desks.—To be formed of 11 in. by 2 in. joists (stepped), notched and spiked to plates.

Roof Boarding.—All the roofs to be covered with 1 in. thick boarding laid diagonally with shot edges and spiked to spars.

Fix stout feather-edge tilting fillet to eaves.

Gallery Floors.—Lay the floors of gallery with 1½ in. thick tongued and grooved flooring, laid very close and cramped, puttied and dressed off, and with rounded nosing and 1½ in. tongued risers.

Seat Backs to Infants' Gallery.—The seat backs to be formed of 1½ in. stuff with rounded edge, held down to seat with angle irons, and to be grooved and tongued to seat.

Wood Floors.—9 in. by 3 in. by 2 in. tongued and grooved best St. Petersburg redwood or pitch pine blocks, set herring-bone pattern in approved asphalte composition.

Doors.—The internal doors to be 2 in. thick framed and panelled doors, and to be fixed with three 4 in. butt hinges to 2 in. thick rebated casings; fix a lock and furniture on each door, and put 4 in. moulded architraves round both sides.

Doors to Latrines.—To be 1 in. ledged and braced batten doors, each door to have two strong wrought-iron cross garnets to 4½ in. by 3 in. beaded and rebated frames. Fix on each door a good barrel bolt and strong wrought-iron thumb latch.

Front Doors.—The front doors to be 2½ in. thick, panelled and stuck moulded, fixed to 4½ in. by 3 in. rebated frames, upper panel prepared for glass, and each to have good barrel bolts and lock and furniture.

Windows.—Fix up the windows with 2 in. double hung sashes with 1 in. moulded bars,

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and in stout deal-cased frames, with 3 in. sunk and weathered English oak sills, to be fitted with brass axle pulleys, woven twine lines, metal weights, and approved strong brass sash fastener.

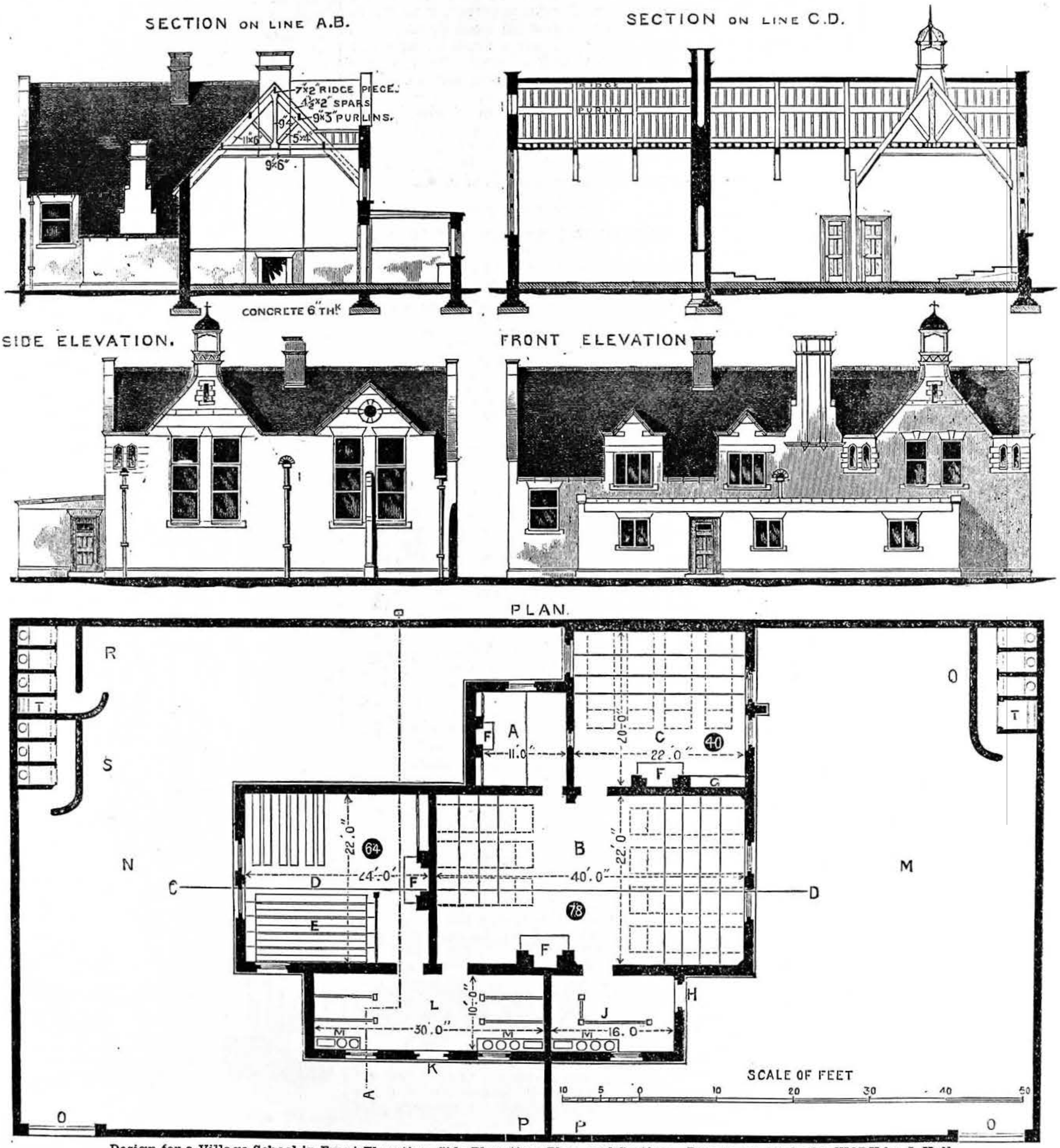
The windows above the transoms of large be hung with 3 in. butt hinges, and fitted with ¾ in. shelves.

All work to be of best quality and left perfect.

PLUMBER.—The eaves gutter to be formed of 5 in. half-round iron gutter, with ½ in. to be covered with 7 lb. lead, neatly dressed over rolls and close copper nailed.

Latrine Cisterns.—The latrine ranges to have each a fifty-gallon flushing cistern, with proper connections.

Turret Roof.—To be covered with 7 lb.



Design for a Village School in Front Elevation, Side Elevation, Plan, and Section. Drawn expressly for WORK by J. Hall.

window and cloak-rooms, etc., to be fitted with pivot-hung sashes on stout pins, and fitted with iron stays.

Line all windows, etc., with 1 in. lining and window boards and 4 in. moulded architraves.

Book Cupboards.—The cupboards to be framed of 1½ in. stuff, panelled and stuck moulded fronts, with 4 in. plinths; doors to

thick wrought-iron straps, fixed to spars. All lead to be best Newcastle milled sheet lead.

Flashings.—All flashings to be of 5 lb. lead, to be tucked and plugged into brick joints, not less than 1½ in., and pointed in oil mastic, and to be 6 in. under tiles with a small concealed gutter.

Cloak-room Roofs.—The cloak-room roofs

lead, and neatly dressed over rolls, and close copper nailed over edge of moulding.

PAINTER.—All materials to be of best quality, and painting to be finished to approved tints.

All white lead to be of the best quality of old white lead, and properly mixed with boiled raw linseed oil and turps, with colours ground in.

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Wood and Ironwork.—All wood and ironwork to be painted four coats good oil colours.

The sashes to be painted cream white, and doors, window-frames, etc., sage green.

All ironwork to be painted dead black.

The whole of the work to be carried out to the true intent and meaning of these plans and specifications, as may be reasonably inferred therefrom, and to be carried out in every respect in the most workmanlike manner, all omissions to the contrary notwithstanding.

The recent introduction of Free Education, and the probability of the establishment of village schools in localities where at present none, or mere apologies for them, are to be found, have induced the proprietors of WORK to place at the disposal of any who may be disposed to avail themselves of them the Design and Specification above given. The proprietors have much pleasure in calling the attention of School Managers and Teachers to these helps to School Building, which are placed at their disposal for the mere cost of the present number of WORK.—ED.

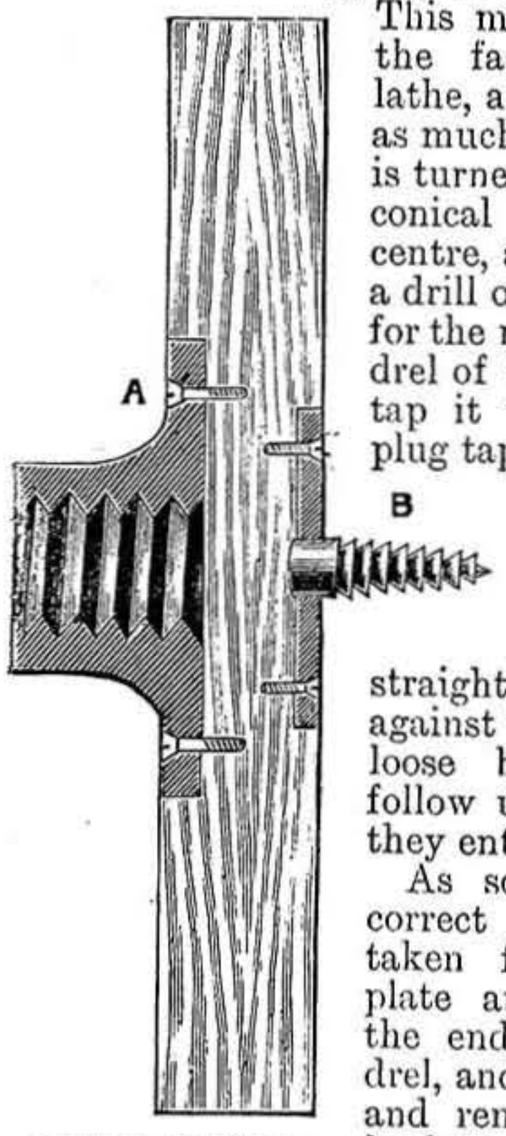
A CHEAP LATHE CHUCK.

BY T. R. BLACKETT.

THE accompanying drawing represents a section of a flange chuck with taper screw, the cost of which, if purchased, would be at least 5s. I made one a short time ago similar to the sketch, which cost about 2s.

The drawing is half full size, but the size may be varied to suit any lathe.

A brass casting, A, must be procured. This must be fixed on the face-plate of the lathe, and the back, or as much of it as can be, is turned true. Turn a conical hole in the centre, and drill it with a drill of a suitable size for the nose of the mandrel of the lathe; then tap it with taper and plug taps till it is a fit for the screw on the end of the mandrel. In order to keep the taps straight, fix their ends against the point of the loose headstock, and follow up the taps as they enter the chuck.



Section of Cheap Lathe Chuck.

As soon as it is a correct fit, it may be taken from the face-plate and screwed on the end of the mandrel, and the face, edge, and remainder of the back turned true; also drill four holes in the flange for counter-sunk-headed screws.

A piece of dry mahogany, 6 in. diameter and 1 in. thick, must be fixed on the face-plate and faced up, and a recess formed in the centre, which must be an exact fit for the brass casting already turned. The casting must be fixed to the mahogany by four screws, as shown at A. It is then fixed on the screw of the lathe mandrel, and the face and edge of the wood turned true.

A steel taper screw, about 1 in. long and ⅜ in. diameter, must be procured and fixed in a circular plate of brass 2 in. diameter, and which has been turned true; four countersunk holes for screws are drilled in the brass plate. The screw I used cost me 1s. complete, fixed in the plate.

A recess is turned in the centre of the wooden disc already prepared, into which the plate and screw are fixed by screws, as shown at B; the plate must be carefully fitted in, so that the screw runs perfectly true, before the screws are put in. This chuck will be found very useful for turning flat discs and short pieces of wood, which do not require the support of the loose headstock. There is also no fear of damaging the point of the tools in cutting out a ring, as when the flange is of metal.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

71.—NIEDLING'S "ROMANESQUE AND GOTHIC CHURCH DECORATION."

THIS publication is one of the finest samples of modern chromo-lithography that I have had the pleasure of inspecting. When the late Owen Jones—away back among "the sixties"—in one of his Marlborough House lectures on decoration, spoke of the glorious colourings of Gothic ecclesiastical decoration, "in which each and every moulding has its applied colour," he must have had in his mind some of the ancient works which A. Niedling has here re-drawn and coloured with so much skill and art for the benefit of our own times. The six plates contained in the first part show some clever drawing and handling of the figure, besides a wealth of purely conventional ornament of an ecclesiastial character, for bosses, ashlar work, side aisles, groined roof, and perpendicular and horizontal borders, with sacred emblems introduced therein. For the better appreciation of the professional utility of this publication, I am pleased to give a place to the opinion of a skilled and experienced contributor. He says:—"Niedling's 'Church Decoration' should be in the hands of every man who professes to design and execute Gothic decoration. The whole of the designs are very judiciously selected, and contain much that is entirely fresh in form and treatment. The colouring is very charming, and scholarly in every example; and coming, as the work does, at a period when the High Church revival of ecclesiastical art is beginning to make itself felt in all directions, I consider it a valuable acquisition to every architect and decorator who can appreciate the æsthetic and phonetic beauties of pure Gothic decoration." The price of this publication, consisting of twenty-four sheets, each 18 in. by 12 in., is 48s., or 12s. each four-part division. To those of the artistic cult amongst the friends of WORK who are acquainted with the "Art Decorator," no further evidence of the monetary value of this production will be required. A specimen plate costs 2s.

72.—ZANDER'S "MODERN DECORATION."

I have heard it stated, by one who was very competent to express an authoritative opinion on the subject, that the practice and art of house and church decoration is but in its infancy in this country. Judging by the number of costly books upon the subject which have recently been placed upon the market, there are apparently many publishers who have a like opinion and faith. The above-named work appeals chiefly to professional painters and decorators, and consists of thirty large designs, in chromo-lithography, for the decoration of ceilings, walls of dining- and drawing-rooms, boudoirs, studios, vestibules, staircases, etc. Although the entire work, in its original German edition, is now completed, the first part only of the English reprint is yet in the publisher's hands; the remaining parts will quickly follow. Each part-issue contains six sheets or sets, for wall and ceiling treatment, printed in the finest possible manner, and mounted upon grey-tinted cards. Although the decorative treatments are more characteristic of Continental decoration than of modern British work, they are full of suggestion and instruction to the decorator who strives to display some freshness and originality in his designs. To the practical master-decorator, especially of the provinces, the work would prove of considerable value, and a set of plates, suitably framed, would materially conduce to the artistic tone of his show-room. The work may be obtained complete, in a suitable portfolio, the thirty plates—size about 18 in. by 12 in.—for £3. The price of a single sample plate is 2s. post free; each part, containing six plates in colours and gilding, being published at 12s. I may further mention, as evidence of their artistic excellence, that sample plates may be seen at the German Exhibition.

73.—IMPROVED BOOT FOR SHORTENED LEG.

"One-half the world is occupied in thinking what the other half is thinking of it," is an aphorism which is constantly manifest, in the affairs of life, in appearances that one-half present to the other in general civilised society; and, perhaps, in no aspect more critically than personal appearances. "The knightly man, though obscure," was the aspiration of a princess. The gentleman, the athlete, is the beau ideal of many who are not princesses. If men or women are afflicted by deformity, they wish to conceal it from the world. It is a laudable feeling, and if art or science, tact or talent, can honestly spare the sensitive feelings of the afflicted, it serves humanity sometimes where nature fails. The deformity to feet of men and women is an affliction which is keenly felt by the afflicted when others regard them pityingly. If the deformity is unseen by others, a sense of relief is felt, and feelings spared. Many feet now encased in hideous frames of cork, iron, or leather, of awkward contrivance for pedomotion, are practically perfect feet, the human ill being either in the knee or hip, which has contracted a leg at one of those parts, and to make the legs even in length the club-boot is put on a perfectly healthy normal foot. This has been done almost up to the present time, till a Mr. Tyrrell was called upon to make a club-boot for a perfect foot of a distinguished man. He refused to do

so. "I will make you a pair of boots alike for even tread on the ground, and a boot to fit your foot at its present height from the ground, so that when you stand there will be no difference of boots you rest on, and your trousers will hide the upper boot on your shorter leg." This was common sense, and delighted the afflicted one, and soon led to orders from all parts for double-storey boots for those with hip and knee contractions. Of course, the lady's skirt effectively conceals the upper boot, as do the trousers of a gentleman. The illustration speaks for itself.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Rate of Circular Saws.—Chopstick writes, in reply to A. R. (*Scorrier Saw Mills*) (see No. 128, p. 379):—"I beg to say that I am still of the opinion that it would be extremely difficult to find a joiner who would be willing to saw 3 in. deal with a rip saw. A. R. seems to think that I am a master, but I am only a journeyman, and I should certainly refuse to do so; and if I were a master, I should refuse to allow my men to do so if they would, as the game would decidedly not be worth the candle. I suppose from his letter that A. R. is the proprietor of the Scorrier Saw Mills. If so, of course it is to his interest to sneer at home-made machinery; but I have made and used a saw-bench which not only cut any thickness up to 3 in., but did tenoning and grooving on it, and I intend sending a description of the machine to Work, and, if it is accepted, others will have the chance of proving my words correct. It is scarcely possible to find a joiners' shop without a mortising machine, but I think the circular saw is of far more benefit. A. R. says that he sharpened a joiners' rip-saw, and cut 3 in. pine for two days, and it went grand. I never yet saw one which would cut for two days without sharpening, and I must say that A. R.'s statements will hardly hold water. However, he may think what he likes. I have had experience both ways, which I do not think he has, and I will guarantee that I can saw out as much 3 in. deal in one day, with a labourer to turn, as six joiners can with the rip saw in the same time, and both the labourer and myself work comfortably."

Rate of Circular Saws.—A. R. (*Scorrier*) writes:—"I was not only surprised, but amused, when I read Chopstick's reply to Constant Reader on p. 398, No. 129. In No. 120, p. 251, Chopstick wrote strongly condemning my argument in No. 116, p. 187, *re* 'Rate of Circular Saws,' and tried to convince the readers of Work that it was an easy matter to cut 3 in. deep with a circular saw driven by hand. In his reply to Constant Reader (see p. 398), he said you must not expect to cut 3 in. stuff without some hard work, and it is best to have two men to turn the wheel. Now, I ask, what notice is there to be taken of a man that will support a thing in one number and in another condemn the same? It is like a child getting a rod with which his own back is to be beaten. I hope, when Chopstick gives his promised information to Constant Reader, that it will not be misleading: that he will not try to open one's eyes in one number, and blind them in another. I understand that the object of Work is to enlighten its readers; and those that write letters and replies should write with that intention, and not for the mere sake of argument."

Cost of Patents.—The following is a cutting from the "Inventors' Column" of the Melbourne *Daily Telegraph* of August 8th, by Mr. G. G. Turri, F.S.C.I. I make no apology for reproducing it, as I am sure it will be of interest to many readers of Work:—

"There are so few books on patent law adapted to the taste of the average inventor, that the one now before me is very welcome. It is highly essential the inventor should know certain facts before he takes out patents, otherwise loss ensues. One important point is, 'What do patents cost?' I find the following table in a work entitled 'Patents for Inventions, and How to Procure Them,' by G. G. M. Hardingham, a well-known consulting engineer and patent agent of London:

Country.	Patent Office Charges and Terms.
Great Britain	£154 in 14 years
Germany	£264 in 15 years
France and Colonies	£60 in 15 years
India	£52 in 14 years
United States	£7 in 17 years
Canada	£12 in 15 years.

"To this I add the figures for Australasia:—

Victoria	£8	in 14 years
New South Wales	£5	"
Queensland	£20	"
South Australia	£9	"
Tasmania	£45½	"
New Zealand	£17½	"
West Australia (L.R.)	£15	"
Total for Australasia	£120.	

"These do not include the varying charges of patent agents, and further it will be understood that in most cases the fees are payable in small instalments at intervals, so that any patentee, finding the invention unremunerative, can let the patent lapse, and so avoid paying the great bulk of the above charges. Thus in England only £4 is payable during the first four years. But taking the above table and noting the average annual cost, and bearing in mind the present population of each country, I get the following startling results:—

In United States	The expenditure of 1d. in Patent Office fees gives a monopoly right for a year over	670,000	persons
France		73,000	"
Canada		26,000	"
Great Britain		14,000	"
Germany ...		12,000	"
Australasia ...		2,000	"

"This table is of some value. When federation takes place the Australasian colonies will cease to occupy the miserable position above shown, and will jump to the level of Canada. At present, New South Wales shows 13,000 and Victoria 8,000 to the 1d.; but the other colonies rank terribly low. Let us hope that the rights conceded to patentees in Australia will soon (like the kiss which the lady returned to Rodolph) be *revu corrigé et considérablement augmenté.*

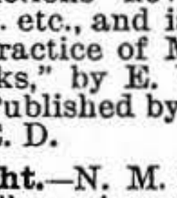
Carpentry Classes.—R. A. P. writes:—"About two years ago I saw a paragraph in the columns of 'Shop,' recommending for 'Tuition in Carpentry,' Mr. S. Robertson, 14, Augustus Road, Hammersmith, who holds evening classes at that address. I at once went to him and joined his classes, finding them of great benefit, so much so that I joined them again the following winter (1890-91), and I fully intend to do so again this winter. They will commence about the end of this month (September) or beginning of next (October), and I should advise your numerous readers—some of whom, like myself, may live in the vicinity, and to whom it might be a convenience and a great benefit—to take advantage of the opportunity. I cannot speak too highly of his merit as a teacher."

II.—Questions Answered by Editor and Staff.

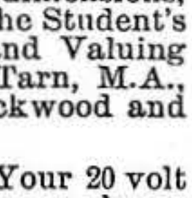
Ash-pan Making.—J. W. (*York*). **Netting.**—J. H. (*West Bromwich*). **Lamp for Lantern.**—Pedagogue. **Door.**—Cowl.—*** The replies to queries on the above subjects must necessarily be given at considerable length to be of any practical utility and value to those who are seeking information on them. The answers are far too long to be included in "Shop," and will therefore appear as short articles in the body of the magazine. "Shop," it should be remembered, is intended to meet the wants of those who are in need of information on any single point connected with any particular subject, and not to deal with subjects themselves from the commencing Alpha to the ending Omega. For the future, contributors must bear in mind that those questions which involve over-long replies cannot be entertained, or must wait to be dealt with by a special paper on the subject.—Ed.

Book on Measurements.—E. H. B. (*Old Trafford*).—I think you will find the book given below to just suit you, as it thoroughly goes into every trade. It gives instructions how to take dimensions, abstracting, etc. etc., and is called "The Student's Guide to the Practice of Measuring and Valuing Artificers' Works," by E. Wyndham Tarn, M.A., price 10s. 6d. Published by Crosby Lockwood and Co., London.—E. D.

Electric Light.—N. M. (*Dundee*).—Your 20 volt 10 c.-p. lamp will require a battery of ten or eleven such cells as you propose to light it efficiently, and the cells will need re-charging every three or four hours. If the zinc plates touch the bottoms of the cells, you may have a layer of mercury in each cell to keep the zincs amalgamated, but the carbon plates must not touch the layer of mercury. If the zincs do not touch the bottoms of the cells, the mercury will be useless. The carbons must have lead heads, but it is not necessary to cast the carbons in a ring of lead. You may employ a set of carbon plates, each furnished with a separate head of lead, as in the carbon plates used in Leclanché cells, or those shown in your sketch. A wood support of teak or of mahogany, well soaked in paraffin wax (as suggested), may be employed to support the plates. Strips of brass or of copper may be fastened to the upper surface of this support, to form connections for the carbon plates. These should be arranged in your cells thus:



not thus:



as shown in your sketch. In your arrangement the two outside carbons would be almost useless, as their surfaces would be out of range of action. The large round cells, each with a central plate of zinc, 6½ in. × 4 in. × ⅜ in., flanked by carbons 7 in. × 2 in. × $\frac{5}{16}$ in., as shown above, will be preferable to cells of a smaller size. See that the tang of the zinc plate is well insulated from the connecting strip of brass on the wood support. This strip on one cell must be connected to the zinc of the next cell, and so on through the series. Charge the cells with bichromate of potash or chromic acid, 3 oz. in each pint of water, acidulated with 3 fluid oz. of sulphuric acid (common oil of vitriol). Use No. 16 B.W.G. copper wire to connect the cells in forming the battery, and No. 18 B.W.G. wire to connect the battery with the lamp. I shall have much pleasure in giving you further advice if you require it; but please understand that we do not answer letters by post. Replies must be made in "Shop," and will appear in due course, as space can be found for them.—G. E. B.

Simplex Dynamo.—W. D. (*Belfast*).—Mr. S. Bottone, Electrical Engineer, Wallington, Surrey, can supply you with castings and other materials for making a dynamo of the Simplex pattern. A set of castings, with cast annealed ring armature 3⅜ in. in diameter, and wrought-iron core 4 in. in length by 2 in. in diameter, will cost 12s. 6d.; or with thin iron plates 3 in. in diameter for a laminated armature, at 24s. the set. He does not recommend the H girder armatures for these machines, as they get too hot; but the price would be the same as that of the ring armature. The wire required will be 1 lb. of No. 20 d.-c.-c, on the armature, and 5 lbs. of No. 20 d.-c.-c. copper wire on the field-magnet core. This machine will develop a current of 2 ampères at a pressure of 25 volts, or enough to supply 20 candle-power. I am glad you find Work so useful. The captain of our ship decides on the cargo to be carried, and he alone can say when induction coils will be placed aboard.—G. E. B.

Safety Fuse for Electric Light.—R. C. J. (*Staffordshire*).—Your lamp may be protected from injury by an accidental rush of current by means of a safety fuse, a safety magnetic cut-out, or a suitable resistance placed in circuit with the lamp. Arrange a Cockburn fuse in circuit with the lamp, to melt at, say, twice the normal current taken by the lamp. This will be, for a 100 volt 16 c.-p. lamp, about 1 ampère. Now, No. 36 B.W.G. fusible tin wire will melt with a current of 1 ampère. Arrange, therefore, a short length of this wire as a loop in the lamp circuit with a small weight (such as a ring or a pellet of lead) depending from the loop. Should the current exceed in strength 1 ampère, the fuse will melt and the weight fall, thus cutting the lamp out of circuit. A fresh piece of wire must be put in after each such accident, and this may form the cause of an objection to a safety fuse of this kind. This being so, I should advise the use of a Cunnyngham's or other magnetic cut-out instead of a safety fuse. Magnetic cut-outs are merely electro-magnets placed in circuit with the lamp, together with a make and brake arrangement controlled by an iron armature placed within the influence of the electro-magnet. The armature can be set so as to cut out the lamp when more than 1 ampère is passing through the magnet coil. You can easily devise the necessary arrangements to do this. If this cut-out is used in conjunction with an adjustable resistance, you can alter this at will, and thus effectually guard the lamp. One of the best adjustable resistances for such a purpose is that of a carbon rod dipping into a metal cylinder filled with water. The cylinder and the rod-holder are connected in circuit with the lamp, and the rod is immersed more or less in the water until the desired resistance is secured. A metal pail will do instead of a cylinder. The carbon resistance may also take the form of two strips of carbon resting on a slate base and on each other; the resistance varying with the surface of carbon in contact. As arcs are liable to be formed between the two surfaces, this is not so good as the former form of carbon resistance. In conclusion, I must point out that you cannot (as you suppose) reduce the voltage of the current by means of a resistance. It is the strength of the current as expressed in ampères by an ammeter—not voltage, as shown on a voltmeter—that will be reduced. I am pleased to hear of your success in following instructions given in Work.—G. E. B.

Soldering Zinc to Brass.—Solder.—Scrape the surfaces which are to be soldered quite clean and bright. Moisten the cleaned surface of the brass with a little ordinary soldering fluid (chloride of zinc or killed spirits), and tin it in the usual way by rubbing the hot soldering bolt on the prepared surface of the intended joint. Get the soldering bolt moderately hot, moisten the cleaned zinc surface with a little crude spirits of salts (muriatic acid), and press the zinc with the hot bolt on the tinned surface of brass. This will cause the two surfaces to adhere. The edges of the seam must now be moistened with spirits of salts, a bead of solder applied, and drawn along by the hot soldering bolt to make the joint neat and secure.—G. E. B.

Nickel-plating Steel.—C. V. (*Bath*).—The cause of your failure in attempts at nickel-plating steel is simply want of experience. No book contains definite instructions calculated to meet every difficulty likely to be experienced by amateurs. General laws can only be laid down in books, and these must be applied to by intending experimenters. As you have the "Electro-platers' Handbook," I will quote from it to show you that the general law applicable to your case is there given. On p. 171 you will find: "A successful result largely depends upon the regulation of the current. If this is too intense, the nickel will be thrown on in small hard grains, which will not present any surface capable of being polished; or the deposit will be ragged: that is, specked with tiny blisters, which will cause the metal to strip and leave a ragged appearance on the coat. Both of these defects are due to excessive evolution of hydrogen at the cathode. When small steel articles are placed in the nickeling solution by themselves, this tendency to blister and cast off the coat of nickel is sometimes very troublesome. This fault may be remedied by placing each steel article between two of brass or some other metal, and thus divert part of the current on each side by easier paths." The strength of current must

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be regulated to the strength of your solution. When both are balanced, the deposit will go on all right. Alter the battery, reduce or increase the anode surface, or place this nearer to or farther from the article, until the proper conditions have been found by experience. Your arrangement of vat, rods, battery, etc., are all right. The solution might be denser with advantage. I should advise you to get an experience in depositing nickel on brass and on wrought iron before you attempt depositing on steel. I think you will concede that you are serving an apprenticeship to this trade, and should, therefore, try the easier jobs before attempting such difficult ones as those stated in your letter. Brass and iron may be plated together in one solution after you have mastered their peculiarities by experience.—G. E. B.

Shocking Coil.—T. W. (*Bolton*).—We endeavour to oblige all our readers with replies to their questions, but cannot see our way clear to give you instructions how to make a shocking coil to send a shock through thirty or forty persons at the same time. You have not, evidently, given this question serious consideration in all its bearings, and specially in those relating to the possible consequences following a shock from such a coil. A shock from such a coil might cause death to one or two persons in the ring, should they be suffering from heart disease, or might cause permanent injury to the health of others. Such shocks can do no good; and the practical jokes played with coils are of such a questionable character as to merit severe denunciation.—G. E. B.

Cases for Binding Vol. I. of WORK are on sale by Messrs. Cassell & Co., the publishers of WORK, at 1s. 6d. each. The cause of delay rests entirely with the newsagent.—G. E. B.

Brass Savings Bank.—D. S. (*Glasgow*).—You leave the design to me, but you ought to have said whether you desired one of a geometrical pattern, villa or house, figures, or some fancy object. I give this one, hoping you will find it suggestive. It will be advantageous to have five separate compartments, as then they could be allotted for the use of five different members of a family, or could be disposed for the saving of copper, silver, and gold

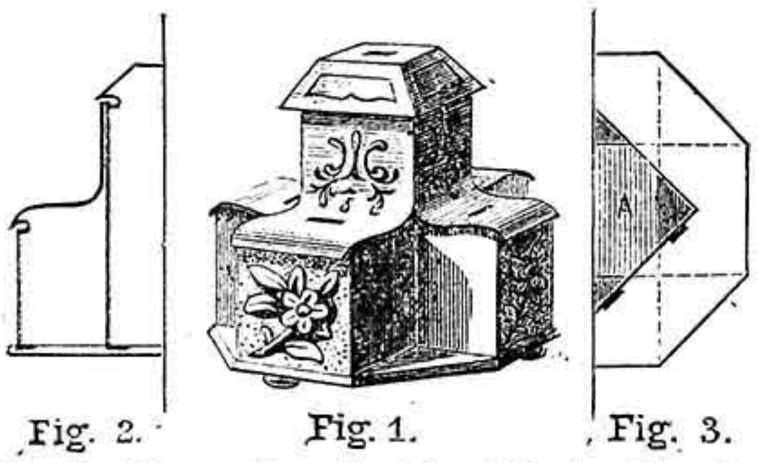

Fig. 2. Fig. 1. Fig. 3.

Fig. 1.—Perspective Sketch of Bank. Fig. 2.—Cross Section (half). Fig. 3.—Plan (half).

coins individually in lots, distinct from each other. I cannot enter into details of constructing this box, beyond saying that I should put it together as in section, Fig. 2; but I believe you will find many useful hints in Mr. Alexander's papers on "Sheet Metal Work," given from time to time. A small square door in the bottom, as in plan, Fig. 3, would, when opened, expose the interiors of all the five compartments, and facilitate easy extraction of the coins within.—J. S.

Wooden Mole-traps.—J. J. (*Cumberland*).—I have made inquiries for a firm who supplies the above wholesale, but am sorry to tell you that I have not succeeded in finding one. Perhaps some of our readers may know, and will oblige us with the information. They have wire springs attached to them, says our correspondent.—J. S.

Improved Watch Key.—D. B. D. (*Glasgow*).—I have examined the sketch sent us, and think it novel, but fail to see that it would pay for the trouble and expense of patenting and introducing to the public, especially as the use of keyless watches is extending, and they are found so much more convenient. It may be urged, in reply, that there are still a great number of key-winding watches in existence, and that, therefore, there must be a good field for the improved key. This is a question more fitted for our correspondent to decide, and must be entirely decided by him.—C. E.

Hydrostatic Clock.—R. F. (*Newcastle*).—I am afraid I do not quite make out what you mean by a "hydrostatic" clock. I do not know of anything by that name; and on turning to the dictionary, I find "Hydrostatics—science which treats of properties and pressure of fluids at rest." And under the circumstances, I do not know how to assist you. No doubt it may be ignorance on my part, for which I apologise. But would the clock illustrated and explained in WORK, No. 125, under the heading "Sand Clock?" If so, I shall be glad to give you any further assistance in my power. It would be easy to make, and would simply require the bottom vessel emptied, say, once a day.—A. B. C.

The Horizontal Position of Drawers.—D. B. D. (*Glasgow*).—A person making an improvement for any purpose which is a novelty, is useful, clearly and properly described, with the claims sufficiently and properly drawn, may obtain a valid patent; but he must distinctly point out in what the novelty consists, and not claim as new anything that has been published or known before. If the inventor our correspondent alludes to has done something in a better way than any known up to that time, he can, of course, go for a patent; but then, it must be so drawn as to be in conformity with the legal requirements in a patent as to enable the law to support; otherwise, such a patent is of no good, and it is waste of time and money to obtain such; and this, it is needless to say, cannot be done unaided by any of the ordinary run of inventors.—C. E.

Provisional Protection.—A CONSTANT READER.—Any inventor who has obtained the grant of a provisional protection for a given thing cannot be considered safe in making it known whilst there is an earlier provisional protection for the same kind of thing open. If the writer is in the hands of a competent agent, or engineer of experience in patent matters, he would be able to carry him through, and advise him as to his best course; but if he—as too many are so fond of doing—has prepared and put in his own documents, he must fight his battle himself, the results of which he will find neither economical, or beneficial, or encouraging. An invention, if good for anything, and intended to be made a property, requires the aid and assistance of one properly qualified to do the required work in a suitable manner; and though a patent is nearly sure to be granted in response to the application, it may be no more a "property" after than before. Inventors and the extensive class who want skilled work and experience to be obtained for nothing will soon find out their folly and ignorance.—C. E.

Perpetual Motion.—F. T. (*Dundee*).—By the above term is usually understood an arrangement and combination of parts of inanimate matter in such a way that, when put together, they shall contain within themselves the power of motion, and keep in motion until the wear and tear of the parts prevent them from continuing to do so. Such an idea, practically, is an utter absurdity; and were it practicable, man would then be endued with the power of *creation*, which is one of the greatest attributes of the Almighty. That some very useful and ingenious movements and combinations have been obtained by the search is very true; but in order that our correspondent may thoroughly understand the subject, he should read "Perpetuum Mobile," by our old friend the late Henry Dircks, C.E., which contains much valuable information on the subject.—C. E.

Sizes of Tapping Drills.—AXLE.—The sizes given in the list below are those I use, and are approximately correct for both cast and wrought iron; though, of course, to be exact the drill should be rather larger for wrought iron than cast, especially in the larger sizes.

Diameter of Screw.	*Diameter at Bottom of Thread.*	*Approximate Size of Tapping Drill.*
¼	·1859	$\frac{3}{16}$ bare
$\frac{5}{32}$	·2413	¼
$\frac{3}{16}$	·2949	$\frac{9}{32}$ full
$\frac{7}{32}$	·346	$\frac{11}{32}$
$\frac{1}{4}$	·3932	$\frac{25}{64}$ ($\frac{3}{8}$ + $\frac{1}{64}$)
$\frac{9}{32}$	·4557	$\frac{29}{64}$ ($\frac{7}{16}$ + $\frac{1}{64}$)
$\frac{5}{16}$	·5085	½
$\frac{11}{32}$	·571	$\frac{9}{16}$
$\frac{3}{8}$	·6219	$\frac{5}{8}$
$\frac{13}{32}$	·6844	$\frac{11}{16}$
$\frac{7}{16}$	·7327	$\frac{3}{4}$ less $\frac{1}{64}$
$\frac{15}{32}$	·7952	$\frac{25}{32}$
1	·8399	$\frac{13}{16}$ + $\frac{1}{64}$

Circular Saw.—A. T. (*No Address*).—You have worked out the speed of your saw spindle correctly; but I cannot say whether it is too fast, as, in speeding a circular saw, the diameter has to be taken into consideration, which you have not given. If the saw is not above 12 in. in. diameter, the speed is not too fast in cutting soft wood. But for cutting hard wood, the pulley should be about 1 in. larger, which would bring it to about the right speed. A. T. should write again, stating gauge and diameter of his saw, also number of teeth, and what the trouble is, and he may expect a definite reply.—A. R.

Dulcimer.—H. J. C. (*London*).—I am very pleased that you have been so successful with your F dulcimer. If you want to make an instrument "suitable to play at a social concert," I should advise you to make one of the D or concert size, the dimensions of which would be: Length, front, 2 ft. 10 in., back, 1 ft. 4 in., depth from front to back, 1 ft. 4 in. Such an instrument is suitable for any work, and stands in a convenient key, but, of course, you could make one to any size you like. If you make one, as you suggest, 3 ft. 2 in. at bottom, and with additional semitones in the bass, that would necessitate the provision of three more bridges on the bass side, and a depth from front to back of 1 ft. 7 in. (The treble is already chromatic.) The additional notes would entirely alter the scale of the instrument, and render it much more difficult to play, on account of the "dodgy" character of the beating which would be necessary. If you build one 3 ft. 2 in. at bottom with the ordinary scale, then the top should be 1 ft. 7 in., and the depth 1 ft. 6 in. To get a full volume of tone out of an instrument of this size, I should advise you to make it with five strings to each note, and to string it with Nos. 11, 10, and 9 brass and Nos. 8 and 9 steel wire. The same width of blocks would do as for an F, as there would be ample room for an additional row of pins on each. Your idea of increasing the sound by replacing the inner bridges with stays similar to those on the back of the sound-board of a piano would have the opposite effect, as these bridges act as sound-posts between back and belly as well as supporting the latter, which, without them, would pucker or swamp as soon as the pressure of the strings was brought to bear upon it. Your question regarding a portable harmonium shall have consideration. In conclusion, allow me to say that if all our correspondents were as explicit as you are they would earn the lasting gratitude of those whose duty it is to reply to them.—R. F.

Patent Drawings.—VERAX.—It is in the interests of patentees that the Patent Office requires the drawings to be clear, black, and well lettered—first, that the photographs taken therefrom for the published specifications may be clear and intelligible: and secondly, that when they come before the courts at a trial, the legal mind can readily follow and understand them. C. C. C. is very much in the habit of dogmatising on Patent matters, and putting himself forward as an authority on a subject of which he has shown and proved himself grossly ignorant—witness, for example, his telling persons who want to make a search to go to the British Museum to examine specifications! and then, when he was shown what nonsense he had been writing, endeavoured to put it off by saying it was needed if an inventor wished to "see the patents at length!"—whatever this may mean. It is pretentious amateurs and dabblers of this description who are misleading inventors, increasing the number of useless and invalid Patents, and causing Patent property to be lightly esteemed and ridiculed. The drawings filed by our correspondent can only be esteemed as rough "sketches," and not by any means as "drawings" in the mechanical sense of the term; and this would be quickly proved if ever they came into the Law Courts.—C. E.

Patent.—ONE OF YOUR CONSTANT READERS.—It is amusing to see the readiness with which persons entirely ignorant of a subject will set themselves up to guide and instruct others, and what useful and infallible authorities they consider themselves! Our correspondent informs us of one of these, who had "registered an idea" (!) at the cost of £1. Now, in the first place, an "idea" cannot be patented. The only thing that can be patented is a *new* manner, method, or mode of performing or producing *something;* and unless a manner, method, or mode is described, such Patent (if granted) would be invalid and useless. The object to be attained in trying to obtain a Patent is the creation of a property, and one which the law will support. Unless this is done, time and money will be wasted, and it is almost needless to add that this cannot be done by the ordinary inventor, though he may put in some papers himself, and get a so-called Patent granted in response. The first thing our correspondent should do is to ascertain if his invention is *novel*, has not been patented before, and that there are no provisional specifications of an earlier date in existence for the same subject. Now, the grant of a provisional protection assures the inventor that no *later* applicant can take precedence of him under the subject of the invention. This provisional protection lasts nine months from the date of application, and before the expiry of this term the complete specification, claims, and drawings must be filed, or the Patent is *lost*. If, however, it is found that what has to be done cannot be completed within that term, an extension of time of one, two, or three months may be applied for, for one of the three periods named, with the stamps for fees of two, four, or six pounds impressed upon the application; but *no further* extension of time will be granted. The cost of a patent will entirely depend upon the amount of work to be done in the search, drawings, specifications, etc.—in fact, unless this is known beforehand, no one can name a price which shall be fair to both parties. The Government fee of £1 on the application no more represents the cost of what has to be done than the penny stamp on a letter settles the value of its contents, or the stamp on a legal document covers the cost of preparing it. If a provisional protection is obtained for an invention under a certain subject, and there are one or more prior provisional protections in existence for the same subject, there is always the risk that, on showing the protected invention, it may be appropriated and embodied in one or other of them, in which case the inventor will be nowhere. A little consideration should satisfy any man of common sense that a person totally ignorant of a given subject is not, and cannot be, qualified to instruct others, or properly to perform what is required therein. If our correspondent has got a thing that is useful and new, let him place himself in the hands of one who knows what has to be done, and how to do it, and is thereby qualified to secure for him what he desires.—C. E.

Contract.—J. P. (*Manchester*).—I can hardly understand from your note the precise nature of your requirements. For instance: do you want to know how to take dimensions off drawings or on the ground? Or do you want a book of prices? The act of contracting really is merely the stating of a certain sum, for which you are prepared to do a specified amount of work. Write for the "Contractors' Compendium and Complete Catalogue," by John Edward Sears, published by the Compendium

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Publishing Company, 16, New Bridge Street, E.C. It states that it is published for 5s., but I know for a fact that it is given free to the trade. You will, I think, find it very useful; for not only does it give a dictionary of manufacturers' specialties, with their illustrations and price, but it also gives a "price book," divided into four sections. Section I., schedule of all trades; Section II., schedule for a dwelling-house; Section III., schedule for a church; and Section IV., builders' measured bill.—E. D.

Clock Case.—G. W. (*Birmingham*).—The works, without cases, can be supplied by any dealer in clocks. There is no difficulty in getting them.—D. D.

Removing Ink Stains.—H. S. A. (*Wolverhampton*).—I do not know of the particular fluid to which you refer as being sold to remove ink stains; but you can easily make one yourself by dissolving some oxalic acid in water. In using this material be careful, as it is a deadly poison.—D. D.

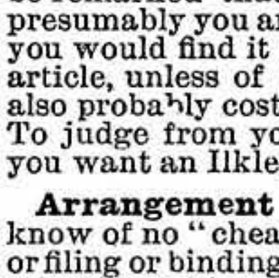
Whitworth Scholarships.—ANGLO-CYMRO.—There are thirty scholarships, each tenable for one year, some of the value of £100, and the rest of £50 each. There are twelve scholarships, tenable for three years, of the value of £125 a year each, four being awarded each year. The limit of age is twenty-six years. The competition is in theoretical subjects; but the candidate is required to have been engaged in handicraft in the workshop of a mechanical engineer for at least three years. The idea is to give as nearly as possible an equal chance to the highly qualified student and to the skilled workman. But for complete particulars I must refer you to the Secretary of the Science and Art Department, South Kensington, S.W., who, on receipt of 3d. in stamps, will send you a full prospectus of the Whitworth Scholarships.—J.

Poker Work.—POKER.—To describe poker work in all its details would require a treatise; but the following hints may be of service:—Well-seasoned, hard, white woods are the best to work upon, as sycamore, box, holly, American white wood, etc. The design to be burnt may be drawn directly upon the wood, or it may be drawn upon tracing paper and transferred to the wood with old carbon paper, old paper being used in preference to new, which marks the wood. The wood must have a smooth surface, such as is imparted by rubbing down the planed surface with fine glass-paper. The design may be burnt out, or the background may be burnt, leaving the design in relief. For etching the lines a special piece of apparatus, costing about £1, is used. You can get it of W. Barnard, 119, Edgware Road, who will also give the necessary instructions about its mode of employment. It consists essentially of a platinum-pointed pencil kept at a high temperature by means of the ignition of benzine or of benzoline blown upon it by means of an air blast. The blast is supplied by means of bellows worked with the foot, or the common double globular pneumatic apparatus, operated by the hand. The air thus pumped passes through an indiarubber tube into a bottle containing the benzine, and forces a spray of the latter out through a second tube into the hollow platinum-pointed pencil. According to the intensity of the blast, the temperature of the pencil point will be greater or less, adapted to fainter or blacker lines. The bottle is never more than half filled with spirit, and when not in use must be tightly corked. The left hand produces the blast, while the right hand is engaged in tracing the design. Two points are required: one for lines and dots, another for backgrounds and deep shadows. The poker points must be kept in movement; if allowed to rest upon the wood, a hole will result. The poker is held very diagonally when working, and is moved indifferently in all directions. The outlining and the grounding lines must meet each other. The work when finished may be stained and polished, or varnished at discretion. French polish can be used, or white, hard spirit varnish, or mastic, or copal varnishes. There is scarcely a limit to the designs, or to the articles of domestic use that may be done by means of poker work, and in clever hands very artistic results are obtainable. But go to Barnard's, just now mentioned, and you may also write to Abbott Brothers, Southall, for prices.—J.

Model Engine.—F. D. (*Devonport*).—I cannot do better than ask your attention to the series now running through WORK, entitled, "How to Make a Quarter Horse-Power Engine." By reducing the dimensions there given, you can get a cylinder of a very pretty type, and there is ample information given as to the fitting up, which is equally applicable to smaller as to larger cylinders.—J.

Tempering Tools.—A CONSTANT READER.—Tools for working granite are hardened and tempered at one operation—that is, they are not let down like metal-cutting tools. There are various plans made use of, the endeavour being to impart excessive hardness combined with some degree of toughness. In every case the tools are heated to a dark cherry red, and quenched at once and for good in a medicated liquid, in which salt, alum, and nitrogenous substances are dissolved. Thus for one: Take half a teacupful of salt, ½ oz. of saltpetre, and a teaspoonful of alum, and dissolve in rain or soft water. Another: Take six quarts of salt water, 1 oz. of corrosive sublimate, 1 oz. of sal-ammoniac, and three handfuls of salt, and dissolve. Another: Take two gallons of rain water, 1 oz. of corrosive sublimate, 1 oz. of sal-ammoniac, 1 oz. of saltpetre, 1½ pints of rock salt, and dissolve. Another: Take three gallons of water, 3 oz. each of ammonia, white vitriol, sal-ammoniac, spirits of nitre, and alum, and 6 oz. of salt, with two handfuls of horse-hoof parings.—J.

Glass Case.—F. G. (*Liverpool*).—Presuming you want a plain case for your model, you cannot do better than make up a framework of wood into which the glass can be fitted either with putty or with wooden strips of beading. As an alternative you may run the glass into grooves ploughed in the wooden framing as suggested in the accompanying illustration, which represents a portion in section.—D. D.



Section of Framing of Case.

Invalid Chair.—J. H. (*Glasgow*).—It will be necessary for you to supply more information as to the kind of invalid chair required before details for its construction can be given. There are so many kinds of chairs or seats for the afflicted that many might be described without meeting your wants. You might say, for example, whether it is wanted merely for sitting in, reclining in at variable angles, or in a fixed position; whether it is to be used for carrying an invalid up and down stairs, and if sanitary conveniences are an essential feature, with any other particulars which occur to you. It may be remarked that unless you are an expert, which presumably you are not from your asking directions, you would find it impossible to make a satisfactory article, unless of the simplest character. It would also probably cost you more to make than to buy. To judge from your letter, I am inclined to think you want an Ilkley couch. Is this so?—D. D.

Arrangement of Cuttings.—NESCIENCE.—I know of no "cheap and handy method of arranging or filing or binding . . . cuttings and scraps on various scientific subjects of all sizes and shapes," but one, and that is to select a size of sheet such as may be most convenient to you—say folio in your case—and paste down the longer articles on single pages, and the shorter scraps in kindred groups on pages set apart for the reception of cuttings on particular subjects. Number your sheets; prepare as full an index as possible; and when you have filled sufficient to make a volume, have the volume bound. In doing things of this kind you must depend, as lady novelists do, on inner consciousness of what is necessary, and from this evolve a method of meeting your own special requirements.

Propeller for Steamers.—E. F. B. (*Liverpool*).—You do not, by your own admission, understand the construction of a "modern high-speed steamer," and yet you "have an idea of a new (quicker and cheaper than the old) method of propelling steamers." I have heard a great deal about new propellers of late years, but no good results have come from any of them. Under the circumstances, be content to leave the matter to experts, who are trying all they know to devise propellers that will drive a ship through the water faster than any that are now in use.

American Watch Movements.—J. SHAW.—All American movements have a pin projecting from the edge of the plate, and this pin fits in a small hole in the rim of the case; pass the pin in this hole, holding the movement face upwards, then press the movement well down into the case, turn the case over, and screw the dog-screws half a turn, to grip the case tight. Swiss movements are fixed in the case the same way; but they have usually three pins, one of which is filed half away, and this one goes in a notch; the other two go under the edge; press down the movement, turn the case and movement over, and give the dog-screws a turn round to hold it in.—A. B. C.

Straining and Mounting Water-colour Tracings.—A BINDER.—It is difficult to handle these by the damp process, unless the colour is mixed (in use) with gum or a weak isinglass size to fix it. If very carefully treated the tracing may be maintained by steam from a kettle, of course holding the back to the steam spray, then just paste the *edges only* for ¼ in., and lay down. The other and the easiest way is to provide a strainer, similar to those used for oil paintings, and nail down your calico, then wedge out your strainer. These strainers can be purchased for a few pence of any dealer in artists' materials.—F. B.

Wardian Case.—W.P. (*No Address*).—A design, with practical instructions for making up the same, is in the hands of the Editor, and will appear as soon as the pressure of other subjects will allow.—C. M. W.

Waterproof Leather.—PLUMBER, *alias* A READER.—The above question was answered in WORK, page 413, column 1, of "Shop."—W. G.

Making Hand-sewn Boots.—S. E. (*Battersea*).—There have not as yet been any articles in WORK on hand-sewn boot making; but there is a series in hand which will, I hope, set you right. The actual thing of your being able to make riveted work will greatly enhance progress in the above, for you have commenced at right end, and the comfort of wearing hand-sewn boots will well repay you for your study and trouble in the future. I hope you have followed up my articles on "Repairing," now appearing, the last of which will soon be published, and as it is on soling and welting hand-sewn boots, it will teach you a lot that you wish to know, as these were intended (although of practical use for the moment) to be a preliminary to the more important set, "Making." There is a book on boot and shoe making, and several touching the subject; but I would not advise you to buy them, for they are very dear, and touch, not one, but all subjects of boot and shoe manufacture. They are written almost expressly for technical students—in fact, they are only technically practical, and not what one might call practical, pure and simple. In fact, that is why I write practical matter, with hints on some of the most simple points, for I myself, years back, needed such instructions, and therefore know others must, in rising, do the same, and not the science of a trade that they know not yet the rudiments. The previous answers in "Shop" ought to have been of great use to you, as you are so far advanced. If you have not an index of Volumes I. and II., you should get them (1d. each). You would see at a glance every number that has anything in it connected with your requirements.—W. G.

Liquid for Curling Hair.—F. R. (*Sunderland*).—It does not come within the scope of WORK to furnish information of this kind. Moreover, no liquid will curl your hair. You must resort, as others do, to curling-irons, curling-pins, or curling-papers.—ED.

Staircasing and Handrailing.—J. W. C. (*Tavistock*).—Articles on these subjects are now being prepared by a competent hand, and the first will appear in the next volume of WORK.—ED.

Architectural Draughtsman.—J. W. C. (*Tavistock*).—It is not possible for me to tell you now where you may get a post of this kind. Why not advertise in WORK, and so catch the eye of some of the many employers who read WORK?

Fittings for Rocking-horse.—RAWTENSTALL.—For eyes, RAWTENSTALL might apply to Messrs. Donziger & Isaacs, Beadmakers, Frederick Street, Birmingham; or, better, to Messrs. E. Schramm and Co., 33, Pershore Street, in the same town; but as these wholesale houses would scarcely care to supply a single pair, we would rather advise RAWTENSTALL to go to the nearest taxidermist. Hair for mane and tail can doubtless be bought from Mr. W. Brabe, Horsehair Manufacturer, Moseley Street, Birmingham. For the priming material with which to coat the body, RAWTENSTALL had better apply to the nearest carver and gilder, who will supply him; but should this be impracticable, he might prime with a mixture of gold size and yellow ochre, pumicing each coat down, when dry, till a sufficiently level surface is obtained.—S. W.

Wheel of Life.—J. F. (*Tipton*).—The exact size of wheel in the zoetrope is immaterial—perhaps one having a diameter of 1 yard would be found efficient; 4 in. square might be given as dimensions for the pictures. The slots must be so large as to enable the eye to take in one picture at a time as the wheel revolves—say, 1 in. long by ⅛ in. wide. Smaller slots require the eye to be brought closer, larger ones make it necessary for the eye to retire. Clark's zoetropes were, we believe, smaller than the above dimensions—the diameter of wheel being 18 in. or 24 in. Clark's, Garrick Street, London, W.C., was formerly the best place to get pictures for the zoetrope; but we are not sure that the business is still carried on; perhaps J. F. had better try E. Schramm & Co., 33, Pershore Street, Birmingham.—S. W.

Glass Lamps and Paper Lanterns for Decorations.—LISFARRON.—We should advise you to go to Messrs. E. Schramm & Co., 33, Pershore Street, Birmingham.—S. W.

Working Models.—W. D. (*Wigston Magna*).—Probably Messrs. E. Schramm & Co., 33, Pershore Street, Birmingham, would be able to supply the sheets of illustrations which you require for cutting up to make these things. These would doubtless come from Germany, and the above German firm import all matters connected with toys.—S. W.

Dolls for Ventriloquists.—VENTRO.—Try Messrs. E. Schramm & Co., 33, Pershore Street, Birmingham; if unable themselves to supply what you want, they will doubtless be able to point out some house that can do so.—S. W.

American Organ.—H. W. (*Southampton*).—I regret to say that the contemplated papers on the American Organ cannot possibly appear in the present volume of WORK.

Folding Sheets for Work.—H. W. (*Southampton*).—There are no plates or illustrations published with the monthly parts of WORK that are not included with the weekly numbers.

Book-keeping.—NESCIENCE.—We know of no work on book-keeping having special reference to manufacturers' accounts beyond the one you mention, namely, Garck and Fell's "Factory Accounts."

Advertising.—G. K. (*Ramsgate*).—Your idea has been anticipated and carried out at various seaside resorts during the summer.

Glass Case for Minerals.—ROB ROY.—A cabinet for specimens of natural history will appear shortly.

Ticket-writers' Ink.—BRIEF.—Replies to correspondents on "Ticket-writers' Ink" appeared in Nos. 24, 38, 46, and 74 of WORK. This information might have been gathered from the indexes to Vols. I. and II., which can be obtained for 1d. each through any bookseller or newsagent.

Staircasing and Handrailing.—N. B. (*Eltham*).—Articles on these subjects will appear separately in Vol. IV. of WORK.

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Engraving on Metal.—N. B. (*Eltham*).—You will obtain the information you require with regard to engraving, the tools that are used, and how to sharpen them, from the papers on this subject, by Mr. Norman Maclean, in Nos. 33, 38, 40, 43, 45, and 48 of WORK.

Carpenters' Bench.—J. V. H. (*No Address*).—Replies are not, and ought not to be, forwarded by post to correspondents. It appears, however, that the contributors did so. Stamps sent in letters do not reach the Editor's office, and are not forwarded by contributors. All letters sent from editorial offices are duly prepaid by the Company. When correspondents send a stamped and addressed envelope, it is generally returned to them with a notification that replies cannot be sent by post.

"Work" Exhibition.—E. M. B. (*Withington*).—There will be no renewal of the "Work" Exhibition this year.

French Polishing.—G. T. (*Bow*).—Articles on this subject have recently appeared in Nos. 105, 108, 115, 117, 119, 122, 123, 126, and 130 of WORK.

Strips of Beaded Mahogany.—S. N. (*Southsea*).—Apply for these of Messrs. Henry Zilles & Co., 24 and 26, Wilson Street, Finsbury, E.C., who will no doubt be able to supply something that will meet your want.

Corner Bookcase.—NOVICE.—A bookcase to stand on a corner cupboard would be practically useless to you and everybody else. You will find a good "Corner Bookshelf Fitting" in Vol. I., page 561; otherwise, No. 36 of WORK; but not even the central compartment of this would stand on a corner cupboard unless the cupboard were abnormally large.

Co-operative Inventive Association.—Inventors may like to know that an Association, Limited, under this name, exists at Newcastle-on-Tyne.

Safety Bicycle.—G. I. (*Lower Broughton*).—Articles on this subject have recently appeared in Nos. 107, 111, 115, 119, 124, 127, and 132 of WORK.

Expanding Envelope.—J. P. W. (*Bristol*).—You must submit your envelope to a practical maker. I cannot undertake, under any circumstances, to advise inventors with regard to their inventions.—ED.

Bedroom Suite.—W. J. (*Portsea*).—No, I cannot undertake to give you "A design and details for a bedroom suite with a duchess dressing-table and drawers, and washstand with a marble top and towel-horse, with two drawers in dressing-table and one each side of looking-glass, and turned legs for both washstand and dressing-table." Have you any idea how many pages of WORK it would take to give you designs, etc., that would be practically useful to you?—ED.

Dulcimer.—P. J. (*No Address*).—You say you "wish to make a good dulcimer." Well, carefully follow the instructions given in the series of articles in Vol. I., and I see no reason why you should not succeed as well as others have done. Ample instructions are given in No. 41, p. 646, for stringing, and the diagram on p. 645 of the same number shows the correct way of tuning. For the rest, I think I had better take your questions *seriatim*. (1) It is found that four or five strings to each note give the best effect, less than this giving a thinner and weaker tone. (2) The degree of softness is regulated by the performer. If a very soft tone is desired, the beaters must be covered with several layers of Berlin wool or other material, and the player himself must exercise his judgment in using them. (3) Any ordinary tune can be played on the instrument, but music of a quick and lively character is the most suitable. (4) The introduction of "more semitones" would only have the effect of confusing the scale and rendering it more difficult to play; as it stands, it is a very easy instrument to learn, and not much knowledge of music is required. (5) It can be tuned to the harmonium, and the two played together make a very pretty and effective combination. (6) Hardly requires an answer, but as there are only twenty bridges on the instrument, it must be obvious that only twenty pieces of wire will be required for them, and that, consequently, forty is an error.—R. F.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Fretwork.—E. B. (*Dorsetshire*) writes:—"I should be glad if some kind reader could tell me of an address where I could dispose of fretwork brackets, cabinets, etc."

Model Steam Launch.—A. M. C. (*Holywood*) writes:—"Will any reader of WORK kindly tell me how to make a model of a steam launch, and where the best place would be to get engines for same?"

Ebony for Walking-sticks.—J. P. (*Hollinwood*) writes:—"Can any correspondent kindly inform me where to buy black ebony for walking-sticks in Manchester?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Carvers' Tools.—PROFESSIONAL writes, in reply to J. D. (*Tiverton*) (see page 631, No. 91), asking for the addresses of makers of the above:—"For straight tools, Addis, Arctic Works, Sheffield; bent gouges, T. Beddall, Malvern Hill Road; Nechells, Birmingham."

Carbon Plates.—W. C. H. (*Godalming*) writes, in answer to J. H. (*Wolverhampton*) (see page 254 of current volume):—"You can obtain carbon plates, 2⅛ in. by 1¼ in., for box battery, as described by Mr. Bonney, at 2s. 6d. per dozen, or 3d. each; also tapped and drilled zincs for same, 2¼ in. by 1 in., at 2s. 6d. per dozen, from Mr. H. Fentum Phillips, Electrician, Stoke, Guildford. He makes amateurs' work a speciality, and is moderate in price."

Rifle Rack.—P. W. (*Devonport*) writes, in reply to A. S. (*London, S.E.*) (see page 334, No. 125):—"I enclose a rough sketch of a rifle rack which I made to take eight carbines. I find it very useful in camp, and think it is something like A. S. asks for. It is very simple, light, and portable. To make it, get two pieces of mahogany board 16 in. long, 7 in. wide by ⅞ in., cut a hole for the tent pole in the centre of the joint, as shown in sketch, and around the front bore eight holes (as shown) the size of the muzzle of the rifle, and get eight plugs turned, as at B, to fit in the holes and down into the muzzle, which will keep the rifle in place. I have a piece of fringe around the front, as shown at Fig. 2, which hides any irregularity in the muzzles not being exactly level, as the ground may not be

Fig. 1

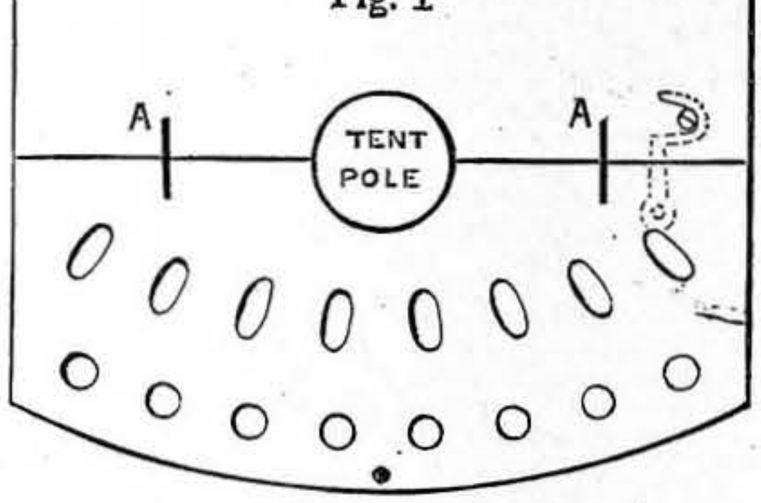

Fig. 2

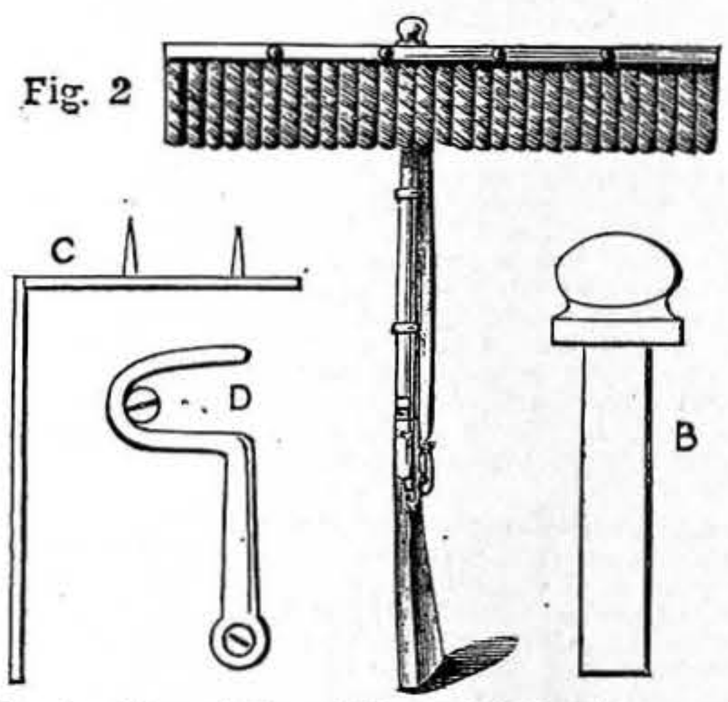

Fig. 1.—Plan of Top of Rack for Eight Rifle Carbines—A, Brass Wire for Dowels; B, Plug for Muzzle; C, Galvanised Iron Squares or Brackets; D, Hooks to fasten the Two Parts together underneath. Fig. 2.—Elevation, showing Carbine standing in Place, and Fringe round Top of Rack.

even. By simply lifting the plug you can immediately free the rifle you require without moving the other seven. The other eight holes at the back of the plugs are to take the swords, which I pass down through the top of the rack into the scabbards underneath. By so doing I do not require the holes so large, and the top is not weakened by having large holes cut in it. Two squares are screwed under the top, close to the tent-pole holes, and are lashed to the pole. The back half serves for a shelf for brush and comb, etc. etc. The two hooks hold the two parts together, and are screwed under the rack. In fixing, it should be 1 in. higher than the length of rifle, as the pole will settle, especially in soft or sandy soil. One or two sconces for candles can be fixed, if desired."

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—F. M. G. (*Glasgow*); E. J. (*Belfast*); GAS-LIGHTER; E. R. D. (*Sherborne*); NEWLAND; W. F. B. (*Rochester*); G. P. (*Tunstall*); R. S. (*Darwen*); RAILWAY; J. B. (*Sowood*); A. M. W. (*Dublin*); A. R. (*Birmingham*); J. H. (*Smethwick*); A. W. (*Leicester*); W. W. (*Sussex*); T. T. (*Darlington*); H. R. K. (*Bedford Park*); A CONSTANT READER; J. T. G. (*Norwich*); SLIDE RULE; C. Y. H. (*Smethwick*); T. H. T. (*Blyth*); J. W. W. (*Renishaw*); OLIVER ASKING MORE; J. G. (*Norwich*); J. E. B. (*Chesterton*); DERF; C. W. S. (*Northallerton*); C. B. A. (*Streatham*); H. J. L. J. M. (*London*); E. E. R. (*London, N.*); FAITHFUL READER; S. & D. (*Harlesden*); T. H. T. (*Blyth*); PROBYN; A. H. (*Nottingham*); W. J.; S. L. (*London*); J. E. G. (*Carmarthen*); TELEGRAPH; TED; C. S. (*Leigh*); S. & B. (*Bristol*); BARIUM; TEBB STREET; W. C. (*Hurst*); TRIPLE EXPANSION; T. G. S. (*Richmond Hill*); G. N. H. (*Marlborough*); A. J. A. (*Notting Hill*); J. D. (*Glasgow*); F. W. L. (*Southborough*); E. M. W. (*Cheltenham*); CAWD HUD; E. P. (*East Finchley*); H. G. H. (*Saxmundham*); G. R. (*Camberwell*); E. E. (*Walsall*).

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The Universal Amateur Exchange.—Electrical, Optical, Mechanical, Chemical, Photographic, etc. Established 1862. Catalogues, 2d.—A. CAPLATZI, Chenies Street, Bedford Square. [8 R

Fretwork.—12 inch Steel Frame, Bradawl, File, Saws, and 40 designs; free, 1s. 8d.—TAYLOR'S Fretworkeries, Blackpool. [11 R

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Dynamo Castings.—List, stamp.—A. King, James Street, Sheerness. [10 R

Buyers of Lathes, Drilling Machines, and all kinds of Engineers' and Amateurs' Tools, are advised to put orders in hand before the busy season.—Call at BRITANNIA CO., 100, Houndsditch, London, or write Britannia Works, Colchester. Small catalogues, 3d., post free. [7 R

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